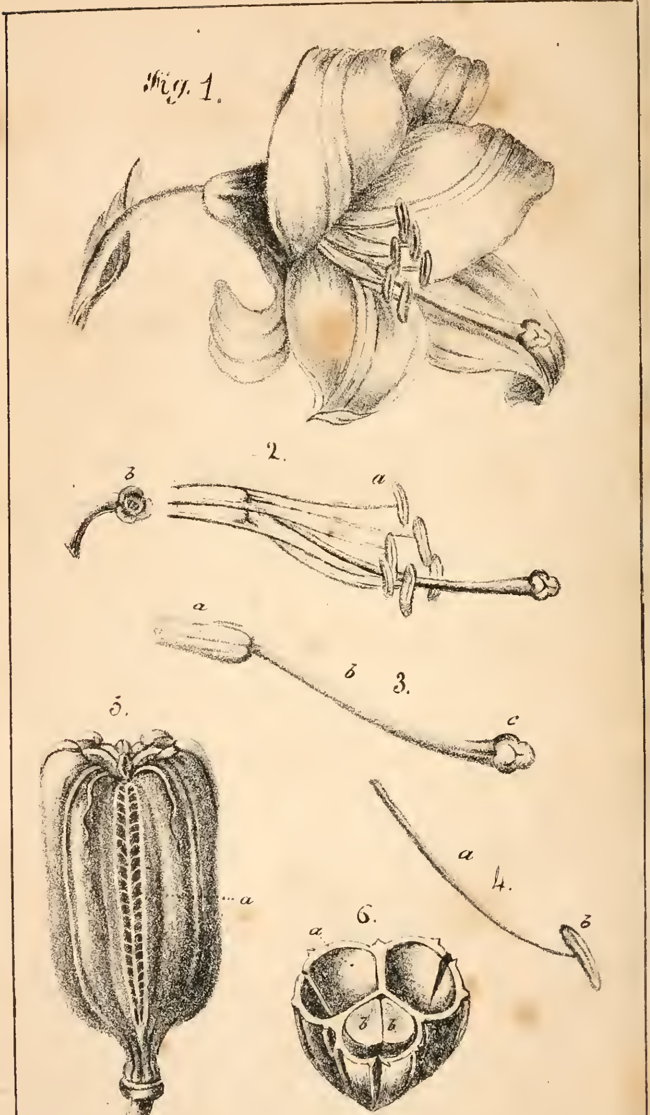
Plate 1.



AN

INTRODUCTION

TO

SYSTEMATIC AND PHYSIOLOGICAL

BOTANY.

By THOMAS NUTTALL, A. M., F. L. S., &c.

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TO THE

HON. JOHN LOWELL, L L. D.

PRESIDENT OF THE MASSACHUSETTS SOCIETY FOR PROMOTING AGRICULTURE, &c. &c.

Sir,

Permit me to lay before you this humble attempt, to render familiar to all, a science, to which I have been so long devoted, and for which your attachment has been conspicuous. If I have failed in my endeavours, to answer this important end, I hope it may be attributed rather to inability, than to any want of zeal to promote the cause of this interesting branch of Natural History. That my imperfect labors may in some degree prove useful, is the sincere wish of

Your humble servant,

THE AUTHOR.

PREFACE.

NEARLY all the elementary works on Botany extant are derived from the *Philosophia Botanica* of Linnæus, a work of great labor and utility to those who would wish to make themselves masters of this fascinating branch of natural knowledge. Its technical character, however, often proves appalling to many who would willingly become acquainted with the characters of plants, did any easier route present itself. The first and most natural enquiry concerning plants, is the nature and character of those beautiful objects we call the flowers ; these, by various interesting qualities, recommend themselves to every one. Their brilliant colors, beautiful forms, fragrant odors, and delightful association with the various seasons of the year, with the promise of fruits and of harvests, all combine to give them an importance, which no other part of the plant possesses. To indulge this shorter route to the knowledge of plants as a science,

after the manner of Rousseau's delightful Letters on Botany, is the object of the present volume. The arrangement of this author, and that of his well known editor, Professor Martyn of Oxford, has been the model on which the author proceeded in the first part of this treatise. The technical history of the herbaceous part of the plant, and the terminalogy as a separate treatise, have appeared to him as scarcely forming any necessary part of a direct introduction to systematic botany, and all its purposes are probably answered by the glossary of terms given at the end of the volume, with the familiar explanations interspersed through some of the first chapters of the work; these, with the aid of the plates and the explanations attached to them, it is to be hoped, will not leave much to acquire of the technical part of the science. To be able at an early period of the study to commence the arrangement of plants by their flowers, and to distinguish them from each other, as well as to contemplate their structure and observe their mutual relations, is a study certainly far more amusing and useful, than a mere attention to the names and characters of the unimportant and unattractive parts of the vegetable.

I must also acknowledge, that, however attractive the natural method of arranging plants may be to myself, I do not yet, for the beginner, know of any sub-

stitute for the Linnæan system: and, indeed, its general prevalence to the present time, after so long a trial, is almost a tacit acknowledgment of its convenience, if not of its superiority over other systems of arbitrary arrangement; for, however natural groups or orders of plants may be in their mutual affinities, all classes and higher divisions of the vegetable system are now confessedly artificial, even among the warmest advocates for a natural method.

Of the *second* part of this work I have but little to say, as it is chiefly an abridgment of a very laborious and useful work on Vegetable Physiology, making part of a course of Lectures by Mr. Anthony Todd Thompson, published in London, and forming, in the estimation of the author, one of the best treatises on the subject which has appeared in the English language. But a very small part of the volume has been introduced, and that only on the general composition of vegetables, and the structure of the principal parts of the plant. our limits not permitting any thing like a general system of vegetable physiology. If what has been given should awaken a taste for additional knowledge on the subject, the following works may be consulted with advantage. *Grew*, on the Anatomy of Plants; *Malpighi*, Anatome Plantarum; *Rudolphi*, Anatomie der Pflanzen; *Kieser*, Mémoire sur l'Or-

ganisation des Plantes ; *Mirbel*, Elémens de Physiologie Végétale ; *Senebier*, Physiologie Végétale ; *Du Hamel*, La Physique des Arbres ; *Hill*, on the Construction of Timber ; *Bauer*, Tracts relative to Botany, London, 1809 ; *Riechel*, de Vasis Plantarum spiralibus ; Histoire d'un Morceau de Bois, &c. par *A. A. du Petit Thouars*, Keith's System of Physiological Botany ; Thompson's Lectures on the Elements of Botany ; Supplement to the Encyclopædia Britannica ; and Mr. Knights' papers in the Philosophical Transactions.

CONTENTS.

PART II.

PHYSIOLOGY OF PLANTS.

AN

INTRODUCTION

TO THE

STUDY OF BOTANY.

CHAPTER I.

THE CHARACTER OF A LILIACEOUS FLOWER.

To acquire a knowledge of the vegetable world, so pleasing to all observers, it may not perhaps be amiss to anticipate the dry detail of technical phrases,* which has but too often deterred, at the very portal of Flora's temple, the enquirer into the nature and character of this beautiful and useful tribe of beings, and begin, at once, by examining plants as we find them, in the manner our predecessors must have done, from whom we have received their history.

We ought then to commence by making ourselves acquainted with the common names of those plants which are around us, and these few objects, known by sight, will serve as so many points of comparison in order to extend our knowledge of the subject.

* A glossary of botanical terms will be found alphabetically arranged at the close of the volume, intended to answer the general purpose of a treatise on terminalogy.

Let us not imagine that the science of Botany ends in the mere acquisition of imposed names; we may become acquainted with the structure of plants and their curious economy, like the human anatomist, without troubling ourselves materially with the particular name given to the individual subject. We cannot, however, proceed far, without employing something like definite language for the several parts of the object under view.

We shall begin, then, by defining a perfect plant to be composed of a root, of a stem with its branches, of leaves, flower, and fruit; for, in Botany, by fruit is universally understood the whole fabric of the seed, and that which contains it; but we must examine more at large the principal part of the plant, namely, the *fructification*, a term which includes the idea of both *flower* and *fruit*. The flower is first offered to us; by it is elaborated nature's choicest and most wonderful work, the mystery of perpetuation; this complicated organ is commonly the most brilliant, symmetrical, and uniform part of the vegetable.

Take a Lily or a Tulip;—at first it is seen in bud, and green; at length it becomes distinctly colored, spreads open, and takes the form of a cup or vase, divided into several segments. This is called the *corolla*, and not the flower, as in common language, because the flower is a composition of several parts, of which the corolla is only the most conspicuous.

You will easily perceive that the corolla of the Lily or the Tulip is not of one piece; when it withers and falls, it separates into six distinct pieces, which are called *petals*. Thus the corolla of the Lily or the Tulip is composed of six petals. A corolla, consisting of several pieces like this, is called a *polypetalous* corolla. If it were all of one piece, like the

Bell-flower, Honeysuckle, or Marvel of Peru, it would be called *monopetalous.* But to return to the Lily.

You will find, exactly in the middle of the corolla, a sort of little column rising from the bottom, and pointing directly upwards; this, taken as a whole, is called the *pistil* or *pointal:* taken in its parts, it is divided into three. 1. The swollen base, with three blunted angles, called the *germ* or *ovary;* 2. A thread placed upon this, called the *style;* 3. The style crowned by a sort of capital with three notches: this capital is called the *stigma.*

Between the pistil and the corolla you find six other bodies entirely separate from each other, which are called the *stamens.* Each stamen is composed of two parts, one long and slender, by which it is attached to the bottom of the corolla, and called the *filament;* the other thicker, placed at the top of the filament, and called *anthera* or *anther.* Each anther is a kind of box or cell, which opens commonly on either side lengthwise when it is ripe, and throws out a yellow dust, which has often a strong odor, and this is called *pollen* or *farina.*

Such is the general analysis of the parts which constitute a flower. As the corolla fades and falls, the germ increases, and becomes an oblong triangular capsule, within which are flat seeds arranged in a double order in three cells. This capsule, considered as the cover of the seeds, takes the name of *pericarp.* In the Tulip the second part of the pistil, or style, is absent. All these parts of the flower, and in the same number, though differing in size and form, will also be found in the single Hyacinth.* The same

* For a figure of these parts as composing a liliaceous flower, see the end of the volume.

parts are found in the flowers of most other plants, but in different proportion, situation, and number. By the analogy of these parts, and their different combinations, the families of the vegetable kingdom are determined; and these analogies are connected with others in those parts of the plant which seem to have no relation to them. For instance, this number of six stamens, sometimes only three, with six petals or divisions of the corolla, and the triangular germ with its three cells, determine the liliaceous tribe; in its most extensive sense, and in many of the most conspicuous genera, the roots partake more or less of the nature of *bulbs*. That of the Lily is a *squamous* bulb, or composed of scales, disposed in an imbricated order, or laid over each other like tiles on the roof of a house; in the onion it is *tunicated*, or consisting of a number of coats laid over each other circularly; in the Tulip the coatings are so indistinct, that the bulb appears nearly solid, and so approaches the nature of the tuberous root; in the Crocus the bulbs appear to grow over each other, or, more properly, beneath each other, for many bulbs have apparently a tendency to descend as long as the soil permits them; in the *Colchicum* they grow out side by side.

Bulbs appear often, if not always, to be produced by the subterraneous continuation of the bases of the leaves, taking upon them a thick and fleshy consistence, and containing within them resources of nourishment for the plant they are destined to support. In the squamous bulbs, also, each scale often appears, like a bud, to possess the germ of an independent existence, so that the species may be increased by planting them. Bulbs have a prolific faculty superior to buds, with which they have been compared, as the scales themselves are capable of budding and growing upwards and downwards; but ordinarily the bud perishes if

taken from its parent trunk, excepting it be done in connexion with a small portion of the *liber*, or inner bark, and be then ingrafted into the trunk of a similar species of plant.

In the bulb, all the nutritious, or cellular part, is carried inwards by the circulation to the support of the bud or embryon plant, after which the coats shrink, and at length turn into those brown scaly coverings, destitute of moisture and of life, which we observe around the Tulip and the Onion.

The Lily and the Tulip, which we have chosen to examine because of the conspicuous size of the flowers and their parts, are, however, deficient in one of the constituent parts of a perfect flower, namely, the *calyx*, which is that outer green part of the flower, usually divided into parts or small leaves, often five in number, sustaining and embracing the corolla at the bottom, and enveloping it entirely before opening, as you may have remarked in the Rose. The calyx, which accompanies so many other flowers, is wanting, in the greater part of the liliaceous tribe; as the Tulip, the Hyacinth, the Daffodil, the Crocus, and Snowdrop, &c. and even in the Onion, Leek, &c. which are likewise, generally speaking, also liliaceous, though they appear so very different at first sight. In the whole of this tribe you will perceive that the stems are simple and unbranched, the leaves entire, never cut or divided; observations which confirm the analogy of the flower and fruit in this family, by the prevailing similarity in the other parts of the plant. By bestowing some attention upon these particulars, and making them familiar by frequent observation, you will be in a condition to determine, by an attentive inspection of a plant, whether it be of the liliaceous tribe or not; and this without knowing

any thing of its name. This is not then a mere labor of the memory, but a study and observation of facts worthy the attention of a naturalist.

CHAPTER II.

OF CRUCIFORM FLOWERS.

Several plants of this very natural family are commonly cultivated for their beauty and fragrance, and may be readily known by the four petals they produce in the form of a cross, from whence the order has derived its name of Cruciferæ. The only difficulty against which we have to guard, on this, as on all other occasions where we examine the luxuriant productions of the garden, is the employment of those monstrous flowers which we term double, as in the Pink, the Rose, the Stock, and Wallflower, in which the stamina become transformed into so many petals, or even give place, as in the Pink, to an almost innumerable quantity of petals, bearing no proportion to the ordinary number of stamens. In what manner this change is produced may often be perceived on examination. Sometimes, as in the Hollihock, it is the anthers which are transformed into petals, but more commonly, as in the Stock and the Rose, the flat filaments become petals. In the Waterlily (*Nymphæ*) the filaments are always a kind of petals, and differ but little, except in color, from the true petals.

Having premised thus much concerning the nature of double flowers, let us now proceed to the analysis of the flower of the single Stock-gilliflower or Wallflower; and here you will immediately perceive an exterior part which was wanting in the liliaceous

flower, namely, the calyx. This consists of four pieces, simply called leaves, without any appropriate name expressive of distinction, as that of petals for flower-leaves, without we adopt the very modern term of *sepals* for these parts, as is done by several eminent French botanists. These four leaves, in our plant, are commonly in unequal pairs, two of them being enlarged or swelled out at the bottom so as to exhibit a very sensible protuberance.

Within the calyx you will find a corolla of four broadish or roundish petals disposed opposite to each other in the manner of a cross. Each of these petals is attached to the receptacle or base of the germ, by a narrow pale part, which is called *unguis* or the *claw* of the petal, and above and out of the calyx spreads the large, flat, colored part, called the *lamina* or *border*.

Each petal, you will observe, instead of corresponding in place with each leaflet of the calyx, is, on the contrary, placed between two, so that it occupies the opening space between them, and this alternate position is common to all flowers having as many petals as leaves in the calyx.

In the centre of the corolla is one pistil, long, and somewhat cylindric, composed of a germ terminated by an oblong stigma which is *bifid*, or cleft into two parts, and reflected backwards.

The stamens in the stock are remarkable for their number and proportion ; there are six, as in the liliaceous flowers, though only four petals, but they are disposed in two sets, namely, four by opposite pairs which are long, and another pair which are short, in consequence of a small gland being interposed between their base and the germ, and which also gives occasion to that enlargement already observed at the base of two of the leaves of the calyx.

I say that the number of the stamina are in this tribe of plants remarkable, for, generally speaking, there exists a symmetrical proportion between the number of the parts of the flower and that of the stamens, where the number does not exceed ten, or where they are constant and definite in quantity, and the principal exception to this rule is in the present class of plants, and in those with gaping or irregular flowers, which, though divided into five unequal parts, commonly produce and perfect only four stamens of unequal length, with occasionally, however, the rudiment of a fifth. The Orchis tribe, (hereafter described,) so singular in every thing else, have also, it is true, only two instead of three or six stamens or masses of pollen, and the Grasses three stamens to a corolla with only two parts.

But to finish the history of the Stock. It is necessary to observe the changes produced on the germ, after the departure of the flower; it now lengthens very considerably, but remains narrow, merely swelling a little with the growth of the seeds. When ripe, it becomes a somewhat cylindric, but flattened pod, called a *silique*.

This silique is composed of two valves or parts, which, at length, fly open from the bottom upwards, and their interior sides form so many cells or chambers for the protection of the seed. These cells are separated from each other by a thin partition, called the *dissepiment*, and the seeds, which are in this plant flat and round, are arranged along each side of the partition, alternately to the right and left by short pedicles to the sutures or edge of the partition.

Botanists distinguish the cruciferous flowers into two orders or sections, from the distinctions apparent in the fruit or seed-vessel. Thus, the first order comprehends those which produce a silique or long pod, as in the Stock, Mustard, and such like.

The second contains those whose seed-vessel is a silicle, or small and short pod, as in the Cress, Candytuft, and Shepherd's purse, where it is almost as wide as long. The most part of these silicles or short pods present valves which are not flat, but hollow, and formed like the keel of a boat; in these the partition or dissepiment is very narrow, and in place of being parallel with the valves, cuts across them or is transverse. This character is not, however, uniform, or without exception, for in *Lunaria* or Honesty the fruit is an elliptic, broad, flat pod, with the dissepiment as wide as the valves, and in *Myagrum sativum* and other genera, the valves, instead of being keeled, are only convex, and have, consequently, the partitions nearly equal, or apparently so, with the valves.* In fine, we meet in nature with none of those broad, abrupt distinctions, which system-makers are so fond of seizing. On the contrary, we every where perceive an interlinking of objects in various directions, not pursuing that regular chain of finite connexion, which some have thought to exist in nature, like a succession of units, each in simple connexion with that which follows or precedes it, but each object is connected variously, so that a view of the relations existing among them would nearer resemble a geographical map, or a tree with its branches, than a chain of simple links.

* For figures of these, and the flowers of the other natural families described, see the close of the volume.

CHAPTER III.

OF PAPILIONACEOUS FLOWERS.

From a fancied resemblance to the butterfly, these plants derive the present name. The same tribe are also distinguished with some botanists by the name of Leguminosæ, from the legume being their uniform fruit or seed-vessel.

The Pea may serve as a type of this very natural and curious family of plants.

The grand division of flowers is into regular and irregular. The regular, present a symmetry and equality in all their parts, each portion forming the segment of a circle, as in the Rose, Tulip, and Pink; in which we perceive no distinction of the flower into an upper and an under part, no difference betwixt right and left; such is the case with the two tribes we have already examined.

But you will perceive, at first sight, that the flower of the Pea is irregular; and that it is readily distinguishable into an upper and an under part. In distinguishing these parts of an irregular flower into upper and under, the natural position of the flower on its stem is always presupposed.

In examining the flower of the Pea, you will first observe a one-leafed, or, technically speaking, a *monophyllous* calyx; that is, one of an entire piece, ending in five distinct leafy points, in two sets, the two wider at the top, and the three narrower at the bottom. This calyx, as well as its peduncle or supporting stalk, also bends downwards, as is, indeed, commonly the case with most flowers at particular times and seasons, for in rainy weather, and at the approach of night, the flowers close their petals, and droop from

their erect posture, to guard, from the injuries of undue moisture, the internal organs essential to the existence and propagation of the plant. In this apparent contrivance of wisdom, the plant itself takes no instinctive share, as it is produced mechanically by the mere descent, or languid motion of the sap, induced by the absence of the light and heat of day.

Having now examined the calyx, (and examine you must, for yourself, if the structure of plants is to be any amusement,) you may now pull it off, so as to leave the rest of the flower in its natural place, and you will now plainly see that the corolla is polypetalous.

The first piece is a large petal, at first covering the rest, and occupying the upper part of the corolla, known to botanists by the name of the *vexillum*, standard, or banner.

The standard being removed, the two side petals to which it adhered are brought to view; these are called *alæ* or the wings, from their peculiar situation and appearance with the rest of the flower.

Taking off the wings, you discover the last piece of the corolla, which covers and defends the stamens and pistillum. This last piece, formed, in fact, of two petals ingrafted together above, is, on account of its form, termed the *carina*, keel or boat.

In drawing downwards this sheathing petal, you bring to view the stamens, which are ten in number, or double the proportion of the other parts of the flower; these are very singular in their disposition, for instead of being so many distinct stamens, they have the filaments joined together at the sides, so as, at first sight, to present a cylinder embracing the pistillum, but they are only so in appearance, and as the germ advances in size, you perceive that the cylinder is cleft above, and that the chasm is closed by a solitary sta-

men; indeed, this separation is always visible at the base of the body of filaments, where one of them appears constantly separated from the rest.

The next great characteristic of this tribe is in the kind of fruit they produce, which we term, *legume*, distinguished from the pod or *silique* of the cruciform plants by its consisting of but a single cell, or without the partition, and having the seeds (peas or beans) attached only to the upper edge or suture. The legume, also, opens lengthwise and rolls backwards, whereas in the silique, the valves separate and roll or stand out from the bottom upwards. The seeds of this tribe have commonly a very marked scar, black spot, or line by which they adhered to the legume, and known to the Botanist as the *hylum*, or umbilical point of attachment. Near this scar there exists a minute opening into the body of the seed, through which vivifying moisture is imbibed at the period of first growth or germination; it continues to swell, and, at length, bursts the imprisoning integument, and now presents, between the divided halves of the pea, the rudiments of the first true leaves, and the short sheathed root. These two hemispheres, which never, as in other plants, expand into proper seed leaves, are still, as well as them, termed *cotyledones*, in allusion to the important part they take in the nourishment and early protection of the infant plant. In the Pea they contain a sweetish farinaceous substance, which is slowly imbibed by the growing embryon, affording nutrition of the most necessary and suitable kind to the infant vegetable, not yet prepared to elaborate the means of its own support. Thus we see, independent of the existence of sentiment or of instinct, in plants, as in animals, a certain dependance on a female parent, which endures from early conception to a period which might be termed adolescence.

These cotyledones or seed-leaves are generally two in number, and indicative of that double system which so generally prevails throughout organic nature. In such plants as the Lilac, Ash, Privet, and many others, this double system, commenced in the seed, is perpetually continued, the leaves coming out in constant pairs; but in many others, as in the Oak, Elm, Chesnut, Beach, and Alder, no opposite, or paired leaves come out after the opposite seed-leaves, so that they appear subject, as in very many other cases, to a perpetual abortion of one half of their supposed existence.

In the liliaceous plants and grasses, however, and some other tribes, there appears to exist no proper leaf-like cotyledones, and the uncleft, unchanged substance of the seed, serves to nourish the growing embryon.

Among the anomalies which nature ever presents to baffle our feeble systems, and to assert her predilection for endless variety, we may observe, that though we can, in general, circumscribe and define with sufficient precision the character of the very natural family of the *papilionaceæ*, yet there exist among them some notable exceptions; thus, in *Amorpha*, there exists but a single petal occuping the place of the vexillum; and the ten stamens, all united into an uncloven cylinder. Nay more, in the *Petalostemon* of Michaux, a plant of the western regions of the United States, resembling Saint-foin, there are no proper petals in their true place, but five of the filaments of the stamens, in place of anthers, developing as many petals, so that the tube presents alternately five anthers and five petals. In the Wild Indigo (*Podalyria tinctoria*), with a truly papilionaceous corolla, there are ten distinct stamens, as there are also in the Judas-tree or

Red-bud (*Cercis canadensis*), and, in this plant, the carina is formed of two distinct petals.

In the common Red-clover (*Trifolium pratense*) all the petals are united together into a tubular base, so that it is, in fact, monopetalous. In the *Cassia*, of any species, (of which the most common, with us, is the *Cassia marilandica*,) the corolla, though evidently unequal in its proportions, consists of five spreading yellow petals, and the stamens, all distinct to the base, are disposed in a triple order, the three near the situation of the carina are furnished with large horn-like black anthers, behind which occur four smaller anthers, and contiguous to the situation of the vexillum three abortive stamens, or mere rudiments; and in the Honey-locust (*Gleditscia triacanthos*) and Coffee bean (*Gymnocladus canadensis*), the papilionaceous character of the flower altogether disappears, the corolla being quite regular, but the fruit, more constantly characteristic of the order, is still a legume containing beans.

In the leguminous tribe are included many useful plants, such as Beans, Peas, Lentils, Lupins, Vetches, Lucern, Saint-foin, Indigo, Liquorice, Kidney-beans. The curious character of the last genus, is to have the keel, and the stamens it includes, spirally twisted.

In this tribe, the United States presents several trees, particularly the common and Honey-locusts, Coffee-bean, and the *Virgilia* of Tennessee.

CHAPTER IV.

OF LABIATE AND PERSONATE FLOWERS.

The flowers we have hitherto examined are polypetalous. We now come to examine a tribe, whose corolla is monopetalous, or of one piece, and also irregular in its outline, and, indeed, altogether so marked that we shall distinguish its members easily by their general aspect. It is that to whose flowers Linnæus has given the name of *ringent*, or gaping, appearing like so many projecting mouths divided into an appropriate upper and under lip. This tribe is separated into at least two orders; one with *labiate* or ringent flowers, properly so called, the entrance into the corolla being always open; and the other of *personate* or masked flowers, from the Latin *persona*, a mask, in which the orifice of the corolla is closed by a prominent palate. The character common to all the tribe is then a monopetalous corolla, divided into two lips, bearing often, under the upper, four stamens in two pairs of unequal length, one of the pairs being longer than the other.

As a specimen of the perfect labiate flower we may take up that of the Balm, Catmint, or Ground-Ivy (*Glechoma hederacea*), the latter remarkable for the disposition of its anthers into the form of a double cross. In the Catmint, you will find a monopetalous, labiate corolla, with the upper lip arched over the stamina; the lower lip is dependent, and consists principally of one rounded, concave, and notched lobe, characteristic of the genus or family. On removing the corolla, which, as in all monopetalous flowers, carries with it the stamina, you will find in the bottom of the calyx, being tubular, lined, and terminated with

five bristly points, four ovules, at length becoming four naked seeds. From the centre of these ovules arises a single style, terminated with a bifid summit or stigma. The corolla, when removed, is open at the bottom, and tubular for the admission of the style, which grows up within it.

Four naked seeds in the bottom of the calyx, and a gaping open corolla is characteristic of the labiate order. They have also very generally square stems, and flowers disposed in whorls or apparent circles round the upper part of the stem. Some of them, as the Rosemary and Sage, have only two stamens. In Sage there are only two filaments supporting two others in an horizontal, moveable posture, and producing an anther only at one of the extremities. In Selfheal (*Prunella vulgaris*) all the filaments are forked, but only one of the prongs bears an anther; most of these plants are highly aromatic, such as Marjoram, Thyme, Basil, Mint, Hyssop, Lavender, &c. or else strong-smelling and fœtid, as the Deadnettle, Catmint, Black Horehound, &c. Some, such as the Selfheal, have but little odor of any kind.

In the *second order* of labiate flowers the seeds are numerous, and produced in a capsule, commonly of two cells and two valves, as in the Foxglove, Toadflax (*Antirrhinum linaria*), and Snapdragon (*Antirrhinum majus*); the corolla is *personate*, having the two lips closed and joined. From the lower lip of the Toadflax depends a spur. In this plant, the Foxglove, *Bignonia*, *Pentstemon*, and many others, there exist the rudiments of a fifth stamen, in accordance then with the five divisions of the calyx and corolla. In that curious variety of the Toadflax, named *Peloria* by Linnæus, the corolla appears in the form of a cone, terminated above by a prominent border of five divisions, and below producing five spurs in place of

one, and five equal and perfect stamens; so that, in this example, we have the ringent flower restored to its natural symmetry and regularity, and though this is consequently the perfect state of the personate corolla, its occurrence is so uncommon that it is hailed as a monstrosity, though the ordinary state alone is, in fact, such! Here then, we have again, as in the irregular papilionaceous corolla, a decided tendency to the regular forms of other flowers, and an additional link of affinity with them in general; this irregularity being only a sort of mask or disguise, produced by that copious source of change, abortion, and imperfection of parts.

CHAPTER V.

OF UMBELLATE PLANTS.

This truly natural assemblage of plants derives its name from *umbella*, an umbrella, in allusion to its particular and characteristic mode of inflorescence, or the disposition of its flowers.

The umbel may be either simple or compound; when compounded, which is most usual, certain general flower stalks (as in the Parsnip and Parsley) growing at the ends of the branches, divide themselves circularly, like the spokes of a wheel, or the skeleton of an umbrella, from a common central point, and form above a round and flat-topped cluster of branches; each branch or partial umbel (the first being the general one) will now be perceived, likewise, to divide itself in a similar circular manner, the true peduncles, or stalks of the flowers, then forming the umbellet or lesser umbel. This primary distinction is only indicative of others which follow, and which are equally essential; and here the situation of the germ with re-

gard to the flower demands some explanation. In the greater number of plants, as the Pink, Foxglove, Tulip, and Primrose, the germ is inclosed within the flower. These have been called *inferior flowers*, as being situated below the germ, though it appears preferable to regard the situation of the germ alone, which in this case is said to be *superior*.

In a much smaller number of plants, the germ occurs below the flower, as in the Gooseberry, Apple, Melon, *Fuschia*, Tree-primrose, and Rose, and is then said to be *inferior*, and the flower superior.

In the Rose and others, this relation of the germ with the flower is ambiguous, as the berry or hep of this plant, apparently inferior, is only the enlarged hollow base of the calyx, rendered succulent, and bearing the seeds attached to its inner side.

The umbelliferous plants have a superior flower, and a corolla of five petals, called regular, though there is frequently an inequality of size between the external and internal petals of the flower.

The petals are generally cordate or heart-shaped, yet inversely so, or obcordate, having the point downward. From the centre of the lobed extremity a point is commonly reflected inwards, which produces that notched, emarginate, or heart-shaped appearance so characteristic.

Between each petal there is a stamen with its anther generally standing out beyond the corolla. Of a proper calyx there is seldom a vestige, except in the Lovage, Angelica, and Water Dropwort (*Œnanthe fistulosa.*)

From the centre of the flower arise two styles, each furnished with its stigma, sufficiently apparent, and these often continue so as to crown the fruit.

The general figure of this fruit is an oblong or oval,

and either flat, as in the Parsnip, or more or less convex or protuberant, as in the Coriander and Parsley; when mature, it divides in the centre into two naked seeds, which for a while, sometimes, remain suspended to a hair like pedicle or receptacle.

A superior corolla of five petals, scarcely any visible calyx, five stamens, and two styles upon a naked fruit, at length spontaneously divisible into two dry seeds, connected with a radiated inflorescence, form the very natural character of the umbelliferous tribe.

The Elder, from its peculiar mode of inflorescence, might perhaps be sometimes mistaken for an umbelliferous plant, as well as some of the species of Cornel, particularly the red-twigged, but the flowers and fruit are quite different, and the apparent umbel is not so in reality, for though the general flower-stalks come out from a common centre, the peduncles or partial flower-stalks come out without any regular order; the whole, however, at a distance presenting a round and flat cluster, has the appearance of an umbel, but is in reality what Botanists term a *cyme*.

The umbelliferous order is somewhat numerous, and so natural as to render it difficult to distinguish the genera. Some authors have given an undue importance to the presence or absence of certain small leaves placed beneath the general and partial umbel, the larger termed *involucrum*, and the lesser, or partial, called *involucellum*. It may be true, that they are pretty generally present or absent in certain genera, but as they are only equivalent to those minute or peculiar leaves which we find under certain flowers, and then called *bractes*, we ought to search for more important characters, connected, if possible, in every genus, with those essential organs, termed the parts of fructification. But in these plants we find nothing, commonly, peculiar in any part of the flower; but in

the seed, when mature, a marked distinction is observable in each genus. In some, as the Parsnip, the seeds are perfectly flat; in Coriander quite spherical; in the Caraway almost cylindric; in the Carrot armed with hooked bristles; in the Hemlock marked with undulating ridges; in *Thapsia* furnished with little margins like wings; in *Cachrys* coated with a large spongy shell, like cork, &c. So that an attention to this particular alone will be sufficient, very generally, to point out the genus.

As specimens of this family, which I may recommend to your examination, may be mentioned the Carrot, Parsley, Hemlock, Lovage, Angelica, Fool's-parsley, Cow-parsnip, Water-parsnip, &c. which have white flowers, and Fennel, Dill, and Parsnip, which have them yellow.

Among this tribe, the Carrot, Parsnip, Parsley, Cellery, Chervil, Skerret, and *Arrekacha* are employed as articles of diet, but most of them, in their natural state, are either poisonous or unwholesome; indeed, most of the tribe are considered dangerous when grown in a wet soil, and several, as the Hemlock, Dropwort, Fool's-parsley, and *Cicuta* or Cowbane, rank amongst the most certain poisons indigenous to Europe and North America. The Fool's-parsley (*Æthusa Cynapium*), as its name implies, has not unfrequently been gathered and eaten with Parsley, which it much resembles in its finely compounded and dissected leaves; its taste, however, is nauseous, and its smell heavy and disagreeable, but the botanist has long pointed out its physical trait of distinction, in the peculiar character of its involucellum, of three long, narrow leaflets depending from the outer base of the partial umbel. The form of its seed is also entirely different from Parsley, being convex, and broader, marked on the back with three prominent

ridges, whereas Parsley has a seed marked with five equal inconspicuous lines.

CHAPTER VI.

OF COMPOUND FLOWERS.

The true character of these common flowers are but little suspected by ordinary observers. Thus the flower of the White-weed or Ox-eye Daisy (*Chrysanthemum Leucanthemum*), but too common in our dry pastures, in place of being a single flower, as every body supposes who has not studied its character, is, in fact, an aggregate of some hundreds of minute flowers, most of them provided with a corolla, stamens, styles, and seed, as perfect in their kind as the flower of the Tulip or the Lily. To be convinced of this, you have only to take it up and examine it with a little care by the help of the most simple microscope. You will perceive that this flower consists of two principal parts, namely, a yellow centre, and a white border. The yellow floscules in the centre, called the *disc* of the flower, and which appear little bigger than so many anthers, consist of a funnel-formed corolla, with a five-toothed border. Within this corolla exists a yellow tube, formed of five anthers joined together in the form of a cylinder; at their base, indeed, the five filaments appear distinct, and are elastic, curling up when torn from the corolla. Through the centre of this tube of anthers passes the style, terminated by a bifid, reflected stigma; below is attached the germ which becomes the seed, and in many of these plants, as in the Dandelion, the seed is crowned by an egret or downy plume, by which it becomes wafted abroad to considerable distances.

The white rays of the border, which look like bits of tape, are also so many distinct florets, but less perfect than the yellew tubular ones of the disc; they are toothed commonly at the extremity, and appear to be tubular florets, cleft open nearly to the base, and deprived of the tube of stamens, but furnished with the style and bifid stigma. The whole of these florets or lesser flowers included within one common calyx, formed, in the White-weed, of numerous scales laid over each other like tiles on the roof of a house or imbricated, constitute this curious assemblage, deservedly called a *compound flower*. The Sun-flower, Thistle, or Artichoke, from their superior magnitude, would best explain the nature of these curious little flowers, which are almost always similar in any other flower that you may discover to be componnd. As might he supposed from the nature of a compound flower, the florets are not all expanded at the same time, and they commonly begin to open at the edge of the disc, and proceed inwards to the centre for a period of several days.

The tribe of compound flowers are divisible into three distinct sections, upon which Linnæus, Jussieu, and others have divided them into orders and tribes. The whole are composed of two sorts of flowers, or rather *florets*, as many, or several of them united in a common calyx go to form the general or compound flower. These florets are all either *tubular*, with a toothed border; or *strap-shaped*, the floret appearing split open, and spread out like a piece of tape, but still retaining the toothed extremity. These were called by old botanical writers *semi-florets*, or halved flowers.

In the first section, then, we may place the *semi-flosculous* flowers, being made up entirely of flat or strap-shaped florets. Such you will find the flowers of

the Dandelion, Succory (or Blue weed), Lettuce, Sowthistle, and others. These plants, so naturally allied to each other, have nearly all the same physical properties; several of them are eatable as salads, though they all possess, at one period or other, a degree of bitterness, and a milky sap of the nature of opium.

The second section comprehends the *flosculous flowers*, or such as are composed solely of the tubular florets, and are, like the preceding flowers, of an uniform color; such are those of Thistles, the Burdock, the Artichoke, Wormwood, and *Liatris*.

In the third general section, the flowers are composed of both kinds of florets; the centre or disc, which is often yellow (as in the White-weed, or Oxeye Daisy), consisting of tubular florets, while the circumference or ray is formed of flat florets generally of a different color from the disc. These have been called *radiate flowers*. The radial florets are generally provided with the style and stigma, but destitute of anthers. In some flowers, as the Sunflower, the rays are entirely barren or destitute of the style; while, on the contrary, in the Marygold, the florets of the disc are abortive, and the flat rays only afford the perfect seed; hence, from this comparative degree of perfection, has Linnæus divided the radiate flowers into different orders of his class Syngenesia.

The general point or place where the florets are seated in a compound flower is called the receptacle, and it usually presents little pits like the summit of a honeycomb; though commonly naked, sometimes this receptacle presents hairs or scales, which are interposed between the florets. The calyx generally consists of a number of divisions or leaflets, either spreading out erect, or closely laid over each other, or imbricated. In the Dandelion these leaves are in a

double row, the outer spreading. In the Thistle the calyx is imbricated, and each scale or leaflet terminated by a spine. But every genus or family of the compound flowers, has its particular marks or characters of distinction to be studied at leisure. At present, we have only to do with the distinguishing traits of the compound flowers; and here one of the most obvious and certain distinctions of this great tribe is the *union* of the *anthers* into a tube. This circumstance alone, will at once direct you, in every case of doubt, to the true and invariable character of the compound class, and hence termed *Syngenesia* by Linnæus, in reference to this growing together of the anthers. But for this character, you might readily suppose that the flowers of the Teasel and the Scabious were indubitably of this tribe, and though they are indeed compound or aggregate flowers, their stamens, only four, are not united or syngenesious.

CHAPTER VII.

OF THE ROSACEOUS FAMILY.

In the family of the Roses are included not only some of the most beautiful ornaments of our gardens, but the principal, and almost only fruits of our orchards. It is divisible, however, into several sections, and in the first, which has been called Pomaceæ, or the Apple tribe, is arranged our fruits, distinguished as follow: The stamens, twenty or more, (or indefinite in their number,) instead of arising from the receptacle or base of the germ, are attached to the calyx, either immediately, or with the corolla, which consists commonly of five petals. The following are characters of some of the principal genera.

In *Pyrus*, which contains the Apple, Pear, and formerly the Quince, the calyx is monophyllous or of one piece, and divided into five segments; the corolla of five petals attached to the calyx; about twenty stamens, also, growing to the calyx, and, indeed, remaining with it in a withered state on the summit of the fruit. The germ is inferior, or immersed in the enlarging fleshy calyx, and there are five styles, corresponding with the five cells containing the seeds buried in the centre of the apple.

The genus *Prunus* or the Plum, comprehending also the Cherry, the Laurel, and till lately the Apricot, has the calyx, corolla, and stamens, nearly as in the Pear. But the germ is superior, or within the corolla; and there is but one style. The fruit is also succulent, contains a stone or nut, and is in technical botanic language then called a *drupe*.

The genus Almond (or *Amygdalus*), including also the Peach and Nectarine, is almost like the Plum, but the germ has often a down upon it; and the fruit, which every body knows to be succulent in the Peach, and dry in the Almond, incloses a hard nut, readily distinguished from that of the Prunus or Plum, by being rough, and full of cavities.

The Pomegranate, Service, and Medlar also belong to this useful section of the Rosaceæ.

The *Rose* itself, and the section to which it more immediately belongs, is easily distinguished by the indefinite and very considerable number of styles, and peculiar nature of its fruit. In the Rose, each style is terminated below by a dry and hairy seed attached to the sides of the persisting and swelling base of the calyx, which, as the hip, acquires a red or yellow color, and fleshy consistence.

Next to the Rose, in the order of affinity or natural relation, comes the *Rubus* or Bramble, which only

differs from the Rose in having the whole calyx spread out flat, and the clustered seeds each coated with a pulp. This is then called a compound berry, and its separate succulent grains, *acini*. To this genus belong the Blackberry, Raspberry, Dewberry, Thimble-berry, and others.

The *Strawberry* has also the flower of the Rose, but the calyx is furnished with five small additional leaflets, and the receptacle becomes a succulent sweet mass covered with the dry seeds, and is thus entitled, as it were, by a slight accident of structure, to the rank of a most delicious fruit. This receptacle when mature is deciduous, or separable from the calyx.

The Cinquefoil, or *Potentilla*, only differs from the Strawberry in the dryness and juicelessness of its seed receptacle; but though some species have also trifoliate leaves, they have more commonly five leaflets, like the fingers of the hand, all arising from the summit of the petiole, or leaf stalk, and hence called digitate. In the barren Strawberry, now very properly referred to Potentilla, the flowers, in place of the usual yellow color, are white, and the leaves trifoliate and ribbed as in the Strawberry; so that here we almost lose the discriminating limits of the two genera, which insensibly pass into each other, and tend, among many other facts of the same kind, to prove, that, in truth, our generic distinctions are only arbitrary helps which we employ for discrimination, and that nature knows no rigid bounds, but plays through an infinite variety of forms, and ever avoids monotony.

Nearly all the fine fruits and flowers of the family of the Rosaceæ which we so generally cultivate, originate in temperate climates. The Apple has been obtained from the wild Crabtree of Northern Europe; the Pear from the very unpromising wilding of

the same country, but bears a warm climate better than the apple. The Quince (*Cydonia*) is found wild in hedges and rocky places in the south of Europe. The Plum (*Prunus domestica*) is likewise indigenous to the south of Europe, but scarcely eatable in its native state. That variety called the *Damason*, or the egg-shaped plum, was probably introduced from Syria. The Peach (*Amygdalus persica*) is the produce of Persia. The Almond occurs wild in the hedges of Morocco. The Cherry (*Prunus cerasus*) is the product of Cerasonte; the Apricot of Armenia; the Pomegranate (*Punica granatum*) of Persia and Carthage.

CHAPTER VIII.

EXPLANATION OF THE CLASSES OF THE LINNÆAN SYSTEM.

The difficulties, defects, and laborious investigation requisite for classing plants by a natural method of arrangement, render it necessary, at least for the beginner, to chose some easier route to the knowledge of plants. For this purpose artificial methods have been invented, and none more successfully applied in practice than that of the celebrated Linnæus.

His classes are founded upon the number and disposition of the stamina, and his orders often upon the number of the pistils.

In comparing a plant by this system, you first examine whether the flowers are complete, or furnished with stamens and pistils, and in the next place, whether the stamens are entirely separate from the pistil, and each other, from top to bottom, or united in some part or other: if they are separate, of the

same or an indeterminate length, and less in number than fifteen, then the number alone will suffice to determine the class ; so those which have one stamen will belong to the first class, entitled *Monandria;* those with two stamens to the second, *Diandria;* those with three to the third, *Triandria;* and so on to the tenth, entitled *Decandria.* These names are derived from the Greek language, as most expressive in composition, and ought to be committed to memory, as they are of constant use and occurrence in this ingenious system.

Flowers in their natural or wild state ought to be preferred by the beginner, to those which are cultivated in gardens, as the exuberance arising from the richness of soil, and an artificial treatment, are often influential in altering the natural number of the parts of flowers; and, in the examples of those which are double, entirely transforming or annihilating the stamens and pistils. A certain symmetry, however, which prevails in the general structure of flowers, will, when understood, serve in a measure to guard the student from error in his decisions on the class and order of a plant ; as, for example, if you meet with a flower whose calyx presents five or ten divisions, and includes five or ten petals, you may constantly expect to find in such flower, if possessed of a definite number of stamens, five or ten of these essential organs, and if the divisions of the flower be four or six, there will be, as a concomitant circumstance, four, eight, or six stamens. As to the rare class *Heptandria*, or of seven stamens, for which the Horse-chesnut is given as an example, it is so irregular, and foreign to the symmetry of the parts of the flower with which it is conjoined, that as a class it might probably be laid aside without inconvenience.

No flower being known constantly possessed of eleven stamens, the eleventh class of Linnæus contained those plants which were said to have twelve, and therefore entitled *Dodecandria;* but as there are scarcely any plants in existence with exactly twelve stamens, all plants were comprehended in this class possessed of any number of stamens from eleven to nineteen inclusive. This slender distinction of number, however, where irregular and inconstant, and more than ten, does not deserve to form the basis of any particular class; and all the plants of Dodecandria, according to the insertion of the stamens, may be conveniently distributed in one or other of the two following classes; for, without this generalizing, species of one natural genus might be dispersed into two different classes, as in *Hudsonia*, where some species are Dodecandrous, and another *Icosandrous!*

All plants having more separate stamens than ten, if we abolish Dodecandria, will belong to one of the two following classes, in which, the mere number of stamens is no longer of importance, being *inconstant*, and the insertion or *situation* of the stamens alone distinguishes the class: thus, in ICOSANDRIA they are seated upon the calyx or corolla (as in the Apple and the Rose); but in the class POLYANDRIA, on the base or receptacle of the flower (as in the Columbine and Poppy). This difference of situation, in this system, is only attended to in the flowers of these two classes, which have many stamens. The name *Icosandria* (from the Greek *εἴκοσι, twenty*, and *ἀνὴρ, a man*, by allusion a stamen), would indicate apparently a class of flowers with twenty stamens; in many of our orchard fruits this is *about* the usual number; but in the Rose and Cactus there are many more, and their insertion alone, either immediately on the calyx, or on the

claws or bases of the petals, decides what plants ought to be referred to this class.*

The class POLYANDRIA (from *πολὺς, many*, and *ἀνὴρ*) differs only from the preceding in the insertion of the stamens, which may be, if we abolish Dodecandria, from eleven to one thousand; these are always situated on the base or receptable of the flower, and fall off with the petals. But in the Rose and many orchard fruits of the preceding class the stamens adhere to the permanent calyx.

In the next class DIDYNAMIA (or of two powers, in allusion to the unequal length of the stamens, which are only four in number), the proportional length is the essential character, two being longer than the other pair. In such flowers, also, there is almost universally an irregularity in the form of the corolla, which is always monopetalous; and, in fact, you will immediately perceive in the *Didynamous* class of Linnæus, the *labiate* and *personate* groups with which you are already acquainted; so that here, as in several other instances, the artificial and natural method of arrangement agree together.

Your *Cruciform* flowers form, also, Linnæus's next class of stamens with different proportions in length, which he terms TETRADYNAMIA. These have four stamens longer than the other two, which gives rise to the name of the class. The flowers are remarkable, in having, contrary to the usual symmetry in the structure, six stamens, and only a calyx and corolla of four parts; yet two of the six stamens

* CALYCANDRIA, in allusion to the insertion of the stamens in this class, would have been a preferable name to that of Icosandria, so commonly deceptive; and such a term, which I had long thought of, has been employed by my friend Dr. Darlington, in his Catalogue of Plants growing round Chester, Pennsylvania.

recede from the rest, and four others are symmetrical with the other parts of the flower.

In the four following classes, the essential circumstance assumed is the union of the filaments or of the anthers.

Thus in MONADELPHIA (or the class of one brotherhood, as the word implies), the filaments are united, more or less distinctly, from their base upwards; but in some genera this character is far from being as obvious as could be desired. In the family of the *Mallows*, which includes the *Hollihock*, this union of the filaments into a column occupying the interior of the flower, is, however, very obvious, and gave rise in former systems to the just application of the term *Columniferæ* to this tribe. Nearly all of them are provided with a double calyx of an unequal number of divisions; the corolla, of five inversely heart or wedge-shaped petals, is united together into one piece at the base, where it also coalesces with the column of stamens; and through the centre of this column, at length, is seen the projecting thread-like styles, being from five, to an indefinite, or considerable number in each flower; whatever be the number, there is at the base a similar number of distinct capsules, or so many united cells forming a single capsule by their adherence. In the cotton plant the seeds are enveloped in a considerable quantity of that kind of vegetable wool which constitutes so important an article of our clothing.

In the next class, the seventeenth of Linnæus, called DIADELPHIA (or two brotherhoods), the united filaments are disposed in two bodies. The flowers have but one pistil; the fruit is a *legume* or pod; and the irregular corolla, termed *papilionaceous*, must at once bring to your recollection a natural group of plants with which you are already acquainted. The *Dia-*

delphous character of this tribe is sometimes quite ambiguous; the united filaments are commonly nine out of ten, the whole number; but there are, as in the *broom* (Spartium), some papilionaceous flowers with all the ten filaments united; and only the curious genera *Sesbania*, and sensitive *Smithia* in which the ten filaments are united in two equal numbers.

In the eighteenth class of Linnæus (by many justly abolished and added to *Polyandria*), there are three or more bundles of stamens, more or less united at the base, and it is hence termed Polyadelphia (or many brotherhoods). In St. John's wort (*Hypericum*) there are species with the filaments in bundles, and others with the stamens simply Polyandrous. In the beautiful examples of *Melaleuca*, this character can be nothing more than generic; as it is, in fact, the principal distinction which separates it from the Icosandrous *Metrosideros*.

The next class, called Syngenesia (in allusion to the peculiar union of the anthers), is perfectly natural, and one with which you are acquainted as the *compound* flowers. In the examination of the Thistle, the Artichoke, and the Sunflower, you will be at no loss to perceive the double character of this class. The apparent flowers, or rather heads, being always formed by the aggregation of several, sometimes some hundreds of lesser flowers, hence called *flosculi* or florets, which in themselves are peculiarly distinguished by having the anthers (always four or five) united into a minute cylinder, but distinguishable as the parts of so many distinct stamens by the disunion of the filaments that rest upon the small corolla.

In the class Gynandria, the 20th of Linnæus, there is a singular union of the stamen and pistillum, sufficiently remarkable among the natural tribe of Orchideous plants, in which the pollen, or fertilizing pow-

der, but little resembling ordinary stamens, is concreted into masses, commonly two, which lie concealed, as in the *Orchis*, within two lateral hoods of the style, or within a moveable or hinged lid at its summit, as in the *Calopogon* and *Arethusa* of our swamps. Very few plants now find place in this ambiguous class, and those which do, particularly the Orchides, are among the rarest and most curious productions of the vegetable kingdom.

The flowers of the plants of the preceding classes, each possessed of both stamens and pistils, have been termed *perfect*, to distinguish them from those of the two following classes, in which the flowers are dissimilar, some producing stamens, but no pistils, and are consequently unproductive of the seed; while others afford pistils and fruit, but are without perfect stamens. These two kinds of flowers are differently circumstanced. In the Cucumber, or Gourd, for example, you will find both sorts of flowers upon the same plant, occupying different situations on the stem; for such plants Linnæus has provided the class which he calls Monœcia (or of *one* house), two kinds of flowers being found on the same plant.

But in the next class Diœcia (or of two houses), as in the Hemp and Spinage, only one sort of flowers are found on a plant, some of them being altogether *pistiliferous* or *staminiferous*. Two different plants are here, therefore, necessary to the perfection of the species; and that such an association of these dissimilarly flowered individuals is requisite in the plan of nature has been proven by the Date palm, as a pistiliferous plant bears no fruit in the absence of the stamniferous individual, and even the pollen itself, when conveyed to a distance, still possesses this fertilizing power, and has been found to act exclusively upon the branch to which it was applied.

In the twenty-third class of Linnæus, POLYGAMIA, now generally abolished as inconvenient in practice, and incorporated with the preceding class *Diœcia*, there are complete and incomplete flowers distributed on two or three different individuals of the same species.

The last, or twenty-fourth class of this system, called CRYPTOGAMIA, from the obscurity of the parts of fructification, merits almost the distinction of a separate kingdom; to it belong the Ferns, Mosses, Lichens, Seaweeds, and Fungusses. In all these, though seed or spora be produced, of extreme minuteness, no distinct corolla, stamens, nor pistils are discoverable, and the fruit itself is so inconspicuous as to be a mere object for the exercise of the microscope. In this tribe, generation appears almost spontaneous, as in the Mould and Mucor, which show themselves readily wherever there is moisture, and in the absence of light so necessary to all other vegetables. Yet even in these, the most simple of organized bodies, appropriate receptacles are provided for the *sporæ* or seminal germs, proving the existence of the universal law of nature, that without a parent mediate or immediate,* neither animal nor vegetable, in whatever part of the scale of existence they are found, can possibly have a being.

* In these, as in all other plants, there are two modes of origin; one from the seed consequent on generation, and giving place to variety; the other soboliferous, individuals protruded as buds or offsets, and, when separated from the parent producing other perfect plants, but possessed of all the qualities of the individual parent.

CHAPTER IX.

EXPLANATION OF THE ORDERS OF THE SYSTEM OF LINNÆUS.

The orders, or secondary divisions of this system, in the first thirteen classes are founded wholly upon the *number* of the pistils; and, like the classes, receive their names from the Greek, as *Monogynia* or *Digynia* the order of one or two styles; the term *gynia*, indicating the feminine or fruit-bearing part of the flower.

In the class Didynamia, including two very distinct natural orders, the pistillum, which is single in them both, affords no longer a numerical distinction, and in consequence, the character of the fruit forms the ordinal distinctions. In the first order, called Gymnospermia (or naked seed), there is no capsule; but a gaping flower, succeeded by four naked seeds within the calyx. In the second order, Angiospermia, the ringent or personate flower is succeeded generally by a two-celled pericarp, containing many seeds.

In the next class Tetradynamia, there is also but a single pistil; so that the two sections, or natural orders, into which it is divided, are again distinguished by the nature of the fruit. In the first order, Siliculosa, the pod is short, or nearly as broad as long, and divided commonly by a narrow or transverse partition into two cells, as in the Cress and Shepherd's-purse; in Lunaria or Moonwort, however, where the silicle is very large and quite flat, the valves and partition are all of the same width. There is almost an insensible passage from one order to the other, Siliquosa, of this class, which differs from the preceding order by having a long and narrow pod, as in the Cabbage, and

Wallflower; also, similarly divided into two cells by a partition, in which last character the pod or silique essentially differs from the legume, or fruit of the Pea and Bean, which has only one cell, with two valves, but no partition, and only a single row of seeds.

In the classes MONADELPHIA and DIADELPHIA, the number of stamens constitute the ordinal divisions, as *Monadelphia Pentandria*, &c. of which the Passion-flower is an example.

In the class SYNGENSIA, or compound flowers, a somewhat complex method is employed to characterize the orders. The comparative perfection of the florets is taken into account, for in this class there exists all degrees of aberration, from the perfect floscules of the Thistle, containing both stamens and styles, to the rays, or neutral florets, in the border of the Sunflower, which are reduced to mere petals, with the rudiments of seed.

It is with this view that the first order of *Syngenesia* takes the appellation of POLYGAMIA ÆQUALIS, polygamia indicates the compound nature of the flower in all the orders but MONOGAMIA (or one marriage); but as this last order is universally abolished, the term *Polygamia* ought also to cease. The order ÆQUALIS, or of equal flowers, indicates that in such compound flowers, as the Thistle and Burdock, every floscule is equally provided with styles and stamens. This order is also subdivided into *flosculosa* and *ligulata*. The flosculous flowers, as those of the Thistle and Artichoke, consist of an aggregate of small tubular flowers, with a regular five-cleft border, but are still distinct from all other simple flowers in the singular character of the class, the *united anthers*. In the second division of the order ÆQUALIS, called *ligulata*, as you may see at once in the Dandelion, all the flowers are still perfect, but the corolla, from centre to circumference,

presents nothing but *flat* or *strap*-shaped florets, notched at the extremity; they may, in fact, be properly considered as so many ordinary florets, with the divisions so closely united, as merely to be ascertained by the number of teeth at the extremity of the strap, but with the whole tubular corolla split open to the base, so as, at first glance, to resemble a single petal, or component of an ordinary flower. This tribe, the *ligulatæ*, are also curiously distinguished from the preceding, or *flosculosæ*, by the physical character of giving out a milky juice on being wounded, which juice partakes, more or less, of the nature of opium, a drug which we derive from a very different family of plants.

In the *second* order, termed Superflua, as you will perceive in the Daisy, Aster, and African Marygold, the florets of the centre or disc of the flower are all perfect, while the flat florets, which form the ray, are merely pistilliferous, and without stamens; but in this order, to distinguish it from *Necessaria*, all the florets perfect seed. Most of the radiate, or bordered compound flowers with which you will meet, belong to this common order.

In the *third* order, called Frustranea, of which you will find an example in the Sunflower and the Rudbeckia, the disc, as in the preceding order, affords perfect flowers, but the rays, excepting an imperfect rudiment of seed, are reduced to mere petals, and have no style.

The *fourth* order, Necessaria, (of which there are but few examples in nature, and none which you can more readily examine than the common single Marygold,) presents a disc of florets apparently perfect, but not so in reality, as they are not succeeded by seed, the rays only affording this prerequisite of future existence. The five native genera, *Silphium*,

Polymnia, Parthenium, Chrysogonum, and *Baltimora,* are nearly all that appertain to this curious order in the United States.

In the *fifth* order, SEGREGATA, which is essentially only a modification of the first, there is, besides the general calyx or involucrum of the whole family, partial or included calyces, each containing one or more florets, which in *Echinops* and *Elephantopus* are perfect, as in ÆQUALIS, and tubular, as in the section *flosculosæ.* This order approaches in some degree the aggregate flowers, such as the Teasel and Scabious, but is at once distinguished as Syngenesious, by the characteristic union of the anthers.

The *sixth* order, now very properly abolished, was termed MONOGAMIA, because it contained plants with *simple,* instead of compound or *polygamous* flowers; but the plants referred to it were completely at variance with all the rest of the class; such were the Violet and Balsam, in which, indeed, no proper union of the anthers takes place.

In the three following classes, GYNANDRIA, MONŒCIA, and DIŒCIA, the orders are founded upon the number and disposition of the stamens, and bear the same names as the foregoing classes, as GYNANDRIA MONANDRIA; and so on.

The class POLYGAMIA, now generally laid aside, was divided into three orders; *viz.* MONŒCIA, when perfect and imperfect flowers existed on the same plant (as may be seen in some Maples); DIŒCIA (as in the Ash), when perfect flowers are found on one plant, and imperfect ones on a second individual of the same species; and TRIŒCIA, when perfect flowers exist on one plant, staminiferous ones on a second, and pistilliferous flowers on a third individual of the same species; of which singular and very uncommon disposition, the common Fig is given as an example;

but, at this time, the three orders of this perplexing class are more readily found, and better arranged in the two preceding classes.

The last class of Linnæus, or more properly grand division of the vegetable kingdom, is called Cryptogamia, from its invisible flowers and obscure fruit. Neither stamens nor pistils, as in the other classes, are here found. The natural divisions alone, then, serve as ordinal distinctions, and four of these orders are commonly adopted; *viz.* 1st. The Filices, or Ferns, by much the largest plants of the class, some of them in tropical climates attaining the stature of trees. 2d. Musci, the Mosses, having the fruit of a very curious and complicated structure. 3d. Algæ, or Seaweeds, whose seeds or *Spora* are immersed or hidden within some part more or less conspicuous of the substance of the plant. 4th. Fungi, or Funguses; such are the Mushroom and Puff-ball, the impalpable dust of which last plant, specifically light as air, consists of innumerable quantities of germs, capable, like seeds, of regenerating individuals, and that to almost any extent, if external circumstances were equally favorable. Indeed the lightness and minuteness of the seeds or spora of this class of plants may readily account for their occasional appearance in places and situations where they are so little expected, that many among them have been brought forward as common examples of the existence of spontaneous vegetation. The indestructibility of many plants of this class is, also, nearly as remarkable as the minuteness and prolificacy of their spora. Many of the same *Lichens* and Seaweeds are found in all situations, and in all climates, tropical, as well as frigid; and we have no reason, consequently, to believe that their means of increase and propagation are less elusive or extensive.

Linnæus, at one period, formed of the palms, which he had not then well examined, a twenty-fifth class. Among the vegetable gnomes which his fancy had created, they were the "Princes of India," bearing their fructification on a *spadix* (or peculiar receptable) within a *spathe;* remarkable for their prodigious height and flowing summit, having an unvaried, undivided, perennial trunk, crowned by a sempervirent tuft of leaves, and rich in abundance of large, (and sometimes) fine fruit.

A TABULAR VIEW

OF THE

CLASSES OF THE SYSTEM OF LINNÆUS.

I. PHÆNOGAMOUS PLANTS, OR WITH CONSPICUOUS FLOWERS.

Classes dependent on the *number* of stamens only.

I.	MONANDRIA.	One stamen.
II.	DIANDRIA.	Two stamens.
III.	TRIANDRIA.	Three stamens.
IV.	TETRANDRIA	Four equal stamens.
V.	PENTANDRIA.	Five stamens.
VI.	HEXANDRIA.	Six equal stamens.
VII.	HEPTANDRIA.	Seven stamens.
VIII.	OCTANDRIA.	Eight stamens.
IX.	ENNEANDRIA.	Nine stamens.
X.	DECANDRIA.	Ten stamens.

Stamens many, indefinite in number, and in which the *situation* is essential.

XI.	ICOSANDRIA.	15 or more stamens on the calyx.
XII.	POLYANDRIA.	15 or more stamens on the receptacle.

Stamens definite, but of *unequal* length.

XIII.	DIDYNAMIA.	4 stamens; 2 longer. Corolla irregular.
XIV.	TETRADYNAMIA.	6 stamens; 4 longer. Corolla cruciform.

Stamens with the *filaments* united.

XV.	MONADELPHIA.	Filaments united in one bundle.
XVI.	DIADELPHIA.	Filaments in two bodies. Corolla papilionaceous.

Stamens with the *anthers* united.

XVII.	SYNGENESIA.	Flowers compound.

Stamens attached to the pistillum.

XVIII.	GYNANDRIA.	Stamens generally one or two.

Flowers of *two kinds*, on the same or on different plants.

XIX.	MONOECIA.	Two kinds of flowers on the same plant.
XX.	DIŒCIA.	Two kinds of flowers on 2 different plants.

II. CRYPTOGAMOUS PLANTS, OR WITH INCONSPICUOUS OR HETEROMORPHOUS FLOWERS.

XXI.	CRYPTOGAMIA.	No proper flowers; and spora for seed.

N. B. The classes omitted have been discussed in a preceding chapter, and the above table is consequently the modified view of the author. The orders are explained in the ninth chapter.

CHAPTER X.

ON THE CLASS MONANDRIA.

We come now to the determination of individual plants, which from classes and orders, descend to genera or kinds, and individuals or species; species are likewise subject to variations more or less constant, as we see in our fruit trees; for instance, in the Apple, of which, all the kinds we cultivate are mere varieties of one original species, called by botanists *Pyrus Malus*, the latter word indicating the name of the species, the former, or *Pyrus*, the genus or kind, and which also includes other species, as the *Pyrus communis*, or Pear, the *Pyrus coronaria*, or sweet-scented Crab of America, &c. This common generic character is applied to all such groups of plants, as, agreeing generally among themselves, present a similarity, not only in the class and order, or stamens and styles, but in the more intimate connexion of resemblance in the flower, and its succeeding fruit; so that while classes and orders are often merely artificial assemblages of plants, a genus always rests satisfied with bringing together such subordinate groups only as are clearly natural; or, while they agree in the structure of flower and fruit, only differ, specifically, in the minor consideration of the forms of leaves, petals, appendages, or slight modifications of parts. It cannot be denied, that, however anxious the systematic botanist may be to draw nice distinctions among kindred genera and species, yet, when he proves so fortunate as to become acquainted with a perfect group of natural or resembling genera, and approximating species, he cannot often help but observe such an interlinking, and gradual passage of one modi-

fication of form into another, as to lead to the belief, that such divisions as genera and species, though generally convenient and lucid in arrangement, are often not really in the original plan of nature, which ever delights in slender shadows of distinction, and while uniting, yet contrives to vary, with an infinite diversity, the tribes of her numerous kingdom.

As instruction in Botany, like all other branches of Natural History, is only attainable by the actual observation of its individual subjects, and the structure of their parts, we shall now proceed, as before, to illustrate the classes by endeavoring to bring before you a few specimens of each; after which, the whole vegetable kingdom, and its numerous individuals (now known to include more than forty-four thousand species), will be accessible to you at will, though never without labor and patience, particularly where the species of a genus are numerous. This difficulty, however, is often much lessened by the different groups or sections into which such genera are divided from some obvious trait of distinction, common to such partial assemblage of species.

The class Monandria contains very few plants, and those principally indigenous to tropical climates, most of them forming part of Linnæus's natural order Scitamineæ, so called, in reference to the spicy and aromatic odor and flavor with which they are so remarkably endowed; such, for example, are the Ginger, Cardamom, Costus, Turmerick, Galangale, and Arrow-root.

The *Canna*, however, which, with the *Thalia* and Arrow-root, are the only plants of this interesting and magnificent family, found native within the limits of the United States, is destitute of the prevailing racy flavor and odor of this tribe. They all agree in general aspect, and resemble so many luxuriant reeds

or grasses, with leaves of an unusual breadth. The flowers are commonly collected into clusters or spikes, which gradually expand, and produce flowers of unusual brilliance, fragrance, or curiosity of structure. Indeed, in the flowers of the genus Canna (or Indian shot), so much augmented by accessions from India, the specific, as well as generic, or family trait, resides mostly in the variations of structure observable in the flower. In all, the calyx, which is superior, or seated upon the fruit, consists of three leaves, the corolla of six parts, as among the Lilies, five of them erect, and the sixth reflected backwards; the seed-vessel is also a capsule of three cells, each cell containing several very hard, and rather large seeds, like Duck-shot, and from hence it has received the common name already given. From such a structure, we should hardly be led to expect the presence of only a single stamen; it is also very curiously and unusually attached to the side of a petal, which answers the purpose of a filament. The style itself, likewise a petal, is entangled or attached to the petaloid filament.

With the curious aquatic plant *Hippuris*, also of this class, possessing scarcely any thing more of flower than a style, anther, and single seed in the bosom of a set of small verticillate or stellated leaves, I will not detain you, as it is too uncommon here for a familiar example; and even the preceding, except in the southern extremity of the Union, are only to be sought for in the garden or green-house.

CHAPTER XI.

OF THE CLASS DIANDRIA.

In studying the plants of this and some other classes, great facility will be derived from attending to the divisions under which the genera are arranged in all the systematic books.

In this class, though not numerous, we shall not find so great a difficulty in obtaining specimens for examination as in the preceding. There are few gardens which do not contain the *Lilac* and *Privet.* They are both provided with an inferior, tubular corolla; with a quadrifid or four-cleft border; but they are distinguished from each other, as genera, by the difference of their fruit; that of the Privet (*Ligustrum*) being a berry with four seeds; that of the Lilac (*Syringa*), a flat and dry capsule of two cells, with many seeds. The species of Lilac may be known apart by the leaves, as, in the common Lilac, where they are heart-shaped; and in the Persian (*Syringa persica*), where they are narrow and lanceolate or lance-shaped; of this last, there is also a variety with the leaves pinnatifid or cleft on either side into parallel segments, after the manner of the divisions of a feather. That it is only a variety is proved, by its seeds producing plants of the ordinary kind, as also takes place in the Parsley-leaved Elder, a mere variety of the common species.

In wastes, by road-sides, where there is a little moisture, in ditches, and in neglected gardens, you will find early in the spring, and late in autumn, a set of very humble plants, mostly introduced by accident from Europe, forming another common genus of plants belonging to this class, called in Europe, Speed-

well, by Botanists, *Veronica*. In these, the corolla, which is extremely fugaceous in warm weather, is flat or wheel-shaped, and monopetalous, commonly white, or bluish, and delicately veined with blue, divided into four segments, and the lowest always narrower than the rest; to this succeeds a two-celled, inversely heart-shaped, or obcordate, flat capsule, containing several seeds. In this genus, as in most others, it is impossible almost to omit observing a symmetry of parts by two and four.

In the *Circæa*, called in Europe, Enchanters' Nightshade (which you will now and then find in our shady woods, which are not too much pastured and exposed), the number two prevails throughout. The calyx is superior and two-leaved; the corolla of two petals; and the pericarp consists of two little burs or capsules which do not spontaneously open, and each of them contains two seeds.

In this, as an artificial system of classification, the mere number and disposition of the stamens are often in danger of severing apart groups of plants, which are otherwise natural. As such, *Salvia*, or the genus of Sage, though really belonging to the Labiatæ, lipped, or ringent flowers, already examined, and which mostly constitute the first order of the class Didynamia, is placed here for no other reason, than its possessing two, in place of four unequal stamens; yet in this genus, characterized entirely by the peculiarity of its stamens, they make no very distant approach to the *Didynamous* character. The filaments of the stamina are, in fact, double, or jointed, for one is articulated across the summit of the other, like a hammer upon its handle, and only one extremity of the transverse filament produces a perfect anther, though there is often an abortive or imperfect rudiment of another at the other extremity.

You will observe the same general structure of flower in the *Monarda* (sometimes called Mountain Balm), but none of this peculiarity in the structure of the stamens; the corolla, also, is very long and narrow, so that the upper lip appears to embrace the filaments of the stamina; the calyx is regular, and the fruit, as in Sage, and all the LABIATÆ, four naked seeds in the bottom of the calyx, though not often all matured.

The leaves, bractes, and divisions of the calyx distinguish the species of *Salvia* from each other. The common officinal Sage of our gardens has hoary wrinkled leaves of an oblong-oval form, and crenulate on the margin; while in Pennsylvania, New York, and to the south, you will frequently meet, in meadows, with a species of Sage (*S. lyrata*) having transversely divided or lyrate leaves, without wrinkles, and almost without odor.

CHAPTER XII.

THE THIRD CLASS.

Of the Grasses.

UNDER this botanical title, or GRAMINEÆ, are also included all the grain we cultivate, in common, as well as Grass, Reeds, and the Sugar-cane. This tribe, almost without exception, have three stamens, and two styles, though but a single seed in a husk. No person, who has ever seen a field of *Maize* (here called *Corn*), at the time when it begins to show a promise of the grain, need be at a loss, on examining the top or panicle of this plant, for the obvious existence of stamens, and every three of them will be found separately included within a small husk of two

leaves; this is called the glume, as well as the second envelope, consisting also of two leaves, but in the situation of the calyx, as the other is in that of the corolla. There is a circumstance in the Maize, however, which is almost peculiar in this family; it belongs to the class MONŒCIA; the upper being barren staminiferous flowers, without styles; the lower aggregated together in a covered spike, are alone fertile and styliferous; in the genus *Zea*, likewise, the styles are undivided, and only one to each grain, but the whole cluster contained in the ear, which is so remarkably long as to be called *silk*, are exserted or come out to the light from all parts of the spike to receive the necessary influence of the *aura* of the pollen or fertilizing powder. This pollen may be observed to fall, at times, almost in a shower from the staminiferous panicle, and consists of spherical grains, nearly as large as the eggs of a moth, which necessarily gravitate towards the lower part of the plant. But how minute the substance necessary to stimulate to life the preexisting germ must be, in this, and perhaps all plants, is sufficiently obvious in the Maize, of whose grain there are several varieties in size, consistence, and color; for, if only a single plant of a deep coloured variety be suffered to grow in a field with the white or yellow kind, an extensive circle of plants which grew in its vicinity apparently unaltered, will, from their seed, often produce individuals bearing deep colored (say red or purple) ears, or grains of some different variety mixed with the ordinary kind, by which the previous parent, though growing at a distance, had been influenced. Nor does the structure of the long and silk-like style present the possibility of an internal passage to the germ of any thing large and gross enough to come under the cognizance of vision, even aided with the most powerful magnifiers. We perceive then here, in

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this instance, and perhaps generally, no necessity for the aid of insects to assist the fertilization of the *Monoecious* or *Dioecous* plants. Nature is all sufficient for the purposes she intended, and never could have left the perpetuation of existence, either wholly or partially, even in plants, to the uncertain and accidental aid of animals.

The general aspect of the Grasses is so similar, and so well understood by all observers, that it is nearly superfluous to enter into any general definition for the Tyro. They vary in duration; those most useful to man, such as grains, are only annual, or perish when they have matured their seed, so that perpetual industry, in providing for their existence, is so much a human requisition, that, as far as we yet know, Wheat, Oats, and Maize, are extinct as wild plants, and now owe their being entirely to that stage of human society, which they so eminently assist to support.

But the greatest number of Grasses are perennial, or exist for an indefinite period, and annually die to the ground. A few in mild or tropical climates only are supplied with woody or enduring stems; such are some of the Reeds, the Sugar-cane, the Cane of the western and southern parts of the United States, and the Bamboo, which becomes so large a tree as to afford a canoe from half of a *culm*, as the Botanists call the stems of all the Grasses; their joints or articulations are also called *nodes*, and from this point alone they produce their leaves and buds. The interior of the culm, in the cane, often produces a secretion of flinty liquor, and the whole epidermis, or outer surface of Canes and Grasses, is in reality glazed with a thin siliceous coating, which in the woody stems readily blunts the edge of a knife.

The leaves of this tribe are arranged along the stem in an alternate order, and attached by means of

an embracing sheath to the cylindric or flattened culm, they are invariably undivided, long, narrow and terminating in a lengthened point. The vessels which compose the leaf, after the manner of the Lilies, and other plants of the great *Monocotyledonous** class of the natural method, go off in right lines, and are never reticulated or branched.

The flowers in the Grasses scarcely deserve the name; they are always herbaceous or greenish like the leaves, from which, even to the philosophic eye, they in reality scarcely differ; for they have no symmetry in the number of parts with the stamens, which are three; the glume being constantly two-valved, or leaved, except as in *Alopecurus* (Foxtail grass), and a few others, where the two leaves are naturally ingrafted together at the sides, and have only two distinct points. The relation of the glume (both that of the calyx and corolla) to mere leaves, or their sheathes, would appear from their alternate order, one being always outside or embracing the other which is interior. The glume of the calyx even sends out a real leaf in Cripsis and the *Spinifex pumilus* of the Missouri. The name *glume*, then, given to the calyx and corolla of the grasses, will serve at once to distinguish this heteroclite class of flowers, there being, in fact, among the Grasses no true calyx or corolla, merely two or three sets of sheathes for the purpose of protecting the stamens. This abortion and anomaly of parts operating against the symmetry of the flower of the grasses goes yet farther, for we find two stigmas to the production of one seed, but that seed is of an irregular form, as you may at once observe in a grain of Wheat, Oats, or Barley, which presents not a cylin-

* So called from the peculiar character of their germination; sending up no seed-leaves or *Cotyledones*, the mass of the seed itself, undivided or *single*, remaining attached to the summit of the root of the young plant.

der, but its half; or rather, it is on one side convex, and on the opposite hollow or grooved. Nor is there any thing like a pericarp, or vessel for the enclosure of the seed in the Grasses, which, destitute of a true flower, are likewise without its concomitant pericarp, and present the rare example of a perfectly naked seed, inclosed only by that substitute which nature has provided for the protection of the stamens. The Grasses, in common with the Lilies, also present anomalies, from the other plants we have examined, in their mode of germinating. After planting the seed of the Radish or Mustard, you perceive that it, at first, developes two leaves, quite different in form and substance from those which succeed; these two leaves are called *cotyledones*, and the great mass of plants which produce them, are, by those who study natural affinities, hence called *Dicotyledones*. In our tribe, the Grasses, a very different arrangement takes place for the nourishment of the infant plant, which could not, apparently, subsist without some such prepared supply. On planting a grain of Corn, Wheat, or Barley, after the protrusion of the germ, and the developement of its leaves, which are all alike except in size, and very different from true seed-leaves, the whole mass of the grain, unaltered in its form, will be found attached, and never transformed into cotyledones. By most of those, however, who study the natural method, this class of plants are called *Monocotyledones*, or plants with one seed-lobe, though with propriety they may rather be considered as destitute of proper seed-lobes altogether, and the germ, merely nourished by a reservoir of inert matter, saccharine in Barley, after undergoing a chemical change, and passing by solution into the vessels of the growing plant. We see, then, here, an additional substitution for true cotyledones, not merely for the Grasses,

but for the whole monocotyledonous class, so called. In the Grasses, then, there are no cotyledones; no true leaves as well distinguished from the glume, when furnished with articulated appendages; no true corolla or calyx; three perfect stamens, in common, though sometimes (as in *Leersia* but a single one); no pericarp; and but a single seed to two stigmas (or styles, as they are commonly imagined, and so classed chiefly in *Digynia*).

The genera of Grasses are distributed commonly into grand divisions for convenience, as you will find in most of the books which treat of the species; and though the false flowers of the Grasses, (for such I must consider them) are often minute, their uniformity is such, as to leave no room scarcely for ambiguity when all the parts are examined; there are frequently two sets of glumes, of two valves each; the inner, inclosing either three stamens, when in flower, or a single seed when in fruit.

In Timothy or Herd's grass (*Phleum pratense*), the long cylindric spike or head, as it is called, consists of very many minute flowers; the outer or calyx glume is very peculiar, each valve being flattened and obtuse, though terminated by a very short bristle, within these two truncated valves is the corolla glume consisting also of two awnless or simple valves.

The *Alopecurus* or Foxtail-grass resembles the Herd's grass, but flowers earlier, bears a soft, in place of a rough spike, and a corolla glume of but one valve, bearing an awn on the back.

In the *Poa*, or Meadow grass, of which there are many species, the flowers are in small heads, called spikelets, and have a general calyx glume, including from 3, or 5, to 40 flower-glumes, which are all consequently destitute of any thing more than the two-valved general calyx, and are without any proper

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calyx to each flower; the flower is compressed so as to appear almost keeled, and destitute of awns. If, with all these appearances, except a roundness and rigidity in the valves, they should gradually terminate in awns or bristles, your plant will be a Festuca (*Fescue grass*), in place of a Poa, a genus of Grasses common in high European pastures, and not unfrequently met with in dry American meadows, and sandy grounds.

But if your plant, with the same appearance generally, should have the corolla glume blunt and awned a very little below the point, it will then be a *Bromus* instead of a *Festuca*.

The Oat (*Avena*) presents a thin membranaceous calyx glume including 2 or 3 flowers, which it exceeds in length; the glume of the corolla is almost of a cartilaginous or horny consistence, two-valved, the dorsal or larger valve producing below its cleft point a conspicuous twisted awn, and, unlike the thin glume of the Wheat, it pertinaciously incloses the grain, in such a manner, as only to be separable by parching in a kiln, which renders it brittle, and assists its separation from the meal which this grain affords, and of which bread is commonly made in the northern parts of Europe. The other species of Avena are only known as Grasses, but not as grain; they are, also, generally perennial, and produce a tall crop of herbage, particularly the *Avena elatior*, which has been cultivated in some of the middle states for hay. The most important grass, however, for cultivation in the middle states, is certainly the Orchard-grass (*Dactylis glomerata*), a stout and tall grass, bearing a panicle (or irregularly branched flowering culm), terminating in many rough clusters of small, flat, and pointed glumes, all in each lobe or cluster inclining one way, and nearly all of the same form and consistence. The seed is small, and falls out of the glume when ripe, though

not very readily. The leaves have almost uniformly a plaited or wrinkled margin when they first expand.

The Reed (*Arundo*) is distinguished by having 3, 5, or more woolly glumes in a common, and rather long, membranaceous calyx. It has also broader leaves than almost any other grass, is nearly aquatic, and generally of a gigantic height, in all the species.

In Wheat the flowers are collected together into a spike of two rows, made up of spikelets or clusters seated on the indented stem or rachis, each calyx containing 3 or 4 flowers, the central ones, for want of room to expand, are rendered infertile, the two outer flowers only producing any grain. The calyx glume, from the magnitude of the seed, becomes broad and boat-shaped, terminated simply by a point, or else by an awn, the larger valve of the corolla also ends in a bristle Nearly all the Wheat cultivated is but one species, and now known to produce many permanent varieties.

The Darnel, Tare or *Lolium*, produces its flowers in a spike almost in the manner of Wheat, but the calyx consists of but a single outer valve, and contains a spikelet of many equal flowers like a *Festuca*. The common species, here naturalized, is perennial, and has beardless flowers; the annual kind, in Europe, though, I believe, seldom in America, overruns fields of grain, and where mixed in any considerable proportion with Wheat, which it resembles, though less in size, produces a bread which is deleterious, and apparently intoxicating.

The delightful and well known vanilla odor of new hay is chiefly produced by the presence of the Vernal-grass, or *Anthoxanthum odoratum*. The flowers, when mature, form a yellow chaffy spike; the calyx,

thin like that of the oat, includes a flower which, at a late period, assumes a brownish tinge, and falls out inclosing the seed, each of its valves produces an awn, one of them nearly from the base, the other from near the tip of the valve ; there are also two minute abortive rudiments of flowers, near the base of the true flower glume. This grass is likewise remarkable for producing only two, in place of three stamens.

Nearly allied to the Grasses are the *Carices*, or Sedges, but they belong to the class and order MONŒCIA *Triandria*, bearing always two kinds of flowers, and those in their structure, as well as that of the seed, entirely different from the true Grasses.

Without possessing any thing specious in their flowers, no class of plants add so much to the beauty of the landscape as the grasses ; their presence marks the distinction between desolate sterility, and verdant plenty ; a very important part of the food of man, and the whole of that of his principal domestic animals depend upon this important tribe of plants. The industry of man is requisite to the very existence of the grain he employs for food, while that part of this family necessary for the food of animals is every where spontaneous, and perennial, and scarcely denied to any climate in the world.

CHAPTER XIII.

THE CLASS TRIANDRIA CONTINUED.

IN the artificial classes of Linnæus, you are not to expect much attention to the natural relations which plants bear to each other, and that consequently, the mere number and disposition of the stamens, however

convenient as a general system of arrangement, does not often justify the approximation of the genera so included. In the same class then with the Grasses, you will meet with other plants of a very dissimilar aspect; such are the natural family of the Iris (IRIDEÆ), including the *Ixia* of the Cape of Good Hope, and the *Gladiolus*, common to the same country, and also to the south of Europe; our garden *Crocus*, which affords the Saffron of commerce, likewise takes its place here. In these plants there is, however, a close relation with the Lilies of the class Hexandria. Like them, they are destitute of a true calyx, and have a corolla of six parts, all the parts or petals nearly alike, except in the *Iris*, which has three larger and differently colored reflected petals, in many species furnished with a central tuft of fringe, commonly compared to a beard; and three erect, and smaller, conniving petals approaching the stigma, which also resembles three other petals; its stigmata or divisions are arched outwards, and under their three concavities you find the three stamens, formed as usual. The whole of these parts of the flower are seated upon the summit of the germ, which eventually, as in the Lilies, becomes a triquetrous or three-sided capsule, divided into three cells, and each cell filled with rows of flat, triangular, brownish seeds. The leaves of nearly all the genus are *ensiform*, or sword-shaped, and make some approach, in the simplicity of their structure, to those of grass; they appear, indeed, to be like sheathing grass-leaves folded up and grafted together, so that their position is rendered vertical; they are thus also thickened, and have both their surfaces nearly similar; but in the quadrangular leaved *Iris* (*I. tuberosa*), as in the *Gladiolus pterophyllus* (or winged-leaved Corn-flag), every apparent leaf may, in fact, be considered as two leaves ingrafted

together by the surface. Unlike most of the family, the Persian, and also the vernal *Iris* (*I. verna*) of Carolina, are possessed of a delicate and fragrant odor, though not equally perceptible to all persons. They differ in the nature of their roots; in most of the species they are progressive horizontal tubers, but a few, as the Persian, and the *Iris Xiphium*, have bulbous roots, like Tulips.

About midsummer, in most of our dry and open fields and meadows, you will frequently meet with something like an *Iris* in miniature, with bright blue flowers, and leaves so narrow and ensiform, as to give it both the appearance and nickname of a grass. This plant, the *Sisyrinchium*, presents terminal spathes or sheathes of two leaves each, sending out from time to time, no inconsiderable number of small flowers, and roundish three-celled capsules. The corolla, unlike the *Iris*, however, consists of six equal spreading divisions, each of them terminating abruptly in a short point, like a bristle; the stamens, three in number, are only known as so many by the anthers, the filaments being so united, as to render it truly monadelphous, but placed here, because of its affinities to the *Iris;* the stigma is three-cleft, but quite inconspicuous, compared with that of the Iris.

In ditches you will not unfrequently meet with a humble, unobtrusive plant, hitherto known only to botanists, by the name of *Proserpinaca.* The stems are undivided above, only a few inches out of the water, with the immersed or drowned leaves finely pinnatifid, in divisions slender as hairs, while the upper leaves, better nourished, are only divided on the margin into serratures, or sharp teeth. In the bosom of these upper leaves, about the months of July and August, you will perceive small greenish flowers, consisting of a superior three-parted persist-

ent (or abiding) calyx; a total absence of corolla; three stamens; and three villous or downy stigmas; to these succeed a hard, almost cartilaginous, three-sided capsule of three cells, with three seeds. This plant, though so unostentatious (allied to the *Miriophyllum* or Water-milfoil), cannot help, still, to amuse the rational botanist intent upon searching out the harmonies and symmetry of vegetable nature. The number three, or six, so extremely uncommon among the great *Dicotyledonous* kingdom of plants, prevails here throughout every part of the flower; and yet, theory would prescribe, both from its germinal character, and affinity with *Miriophyllum*, a number four in place of three, and it is not very uncommon to meet with single flowers in which the quadruple form does, in reality, prevail.

CHAPTER XIV.

OF THE CLASS TETRANDRIA.

Among the curious natural assemblages of plants, included either wholly or partially in this artifical class of four stamens, I will first introduce to your notice the Teasel (*Dipsacus* of Linnæus), constituting the type of comparison for the natural family of the Dipsaceæ, or *aggregate* flowers, which, with the exception of disunited anthers, and commonly only four in number, might readily be mistaken for examples of truly compound or Syngenesious flowers. The Fuller's Teasel (*Dipsacus fullonum*), is a plant extensively cultivated for the purpose of dressing woollen cloth, and inducing upon it a short and finishing knap. Almost all the plants of the genus are large, rough

with spiny tubercles, and possess leaves which generally grow together at their base, and so become perfoliate, or with the stem passing, as it were, through the centre of the united leaf. The flowers are produced in dense cylindric heads, have an involucrum or common calyx of many slender and almost bristly leaves, and also a proper, superior, or crowning calyx, of a single, funnel-formed piece; the corolla (usually pale pink) is superior, and tubular, spreading out above into a four-cleft border; a single seed, as in the syngenesious plants, is produced at the base of the corolla; and the common conic receptacle is provided with narrow, bristly leaves, which are straight in the wild Teasel (*Dipsacus silvestris*), but hooked in the cultivated species (*Dipsacus fullonum*), and it is for this little accident of difference in the termination of these minute receptacular leaves, that the plant is generally cultivated; their curved points, arranged in rows, answering inimitably the purpose of a most delicate card for fine woolen cloth.

The *Scabious* of the gardens, of which the brown-flowered species (*Scabiosa atropurpurea*) is the most common, differs from the Teasel, in possessing a double calyx to each floret, one above, and the other below the seed.

To this artificial class, though to a very different natural order, belongs the common Button-bush, or *Cephalanthus*, so common in swamps, and along the margins of ponds. It is a shrub, bearing, in July and August, a profusion of perfectly globular heads of flowers, each head made up of numerous florets, without any general calyx or involucrum, though furnished with minute four-cleft calyces to each floret; the corolla is tubular and slender, with a four-cleft border; the style is exerted or stretched out greatly beyond the corolla, and the stigma globular; to the

floret succeeds a somewhat woody, 2-celled, 2-seeded capsule, which divides commonly into two parts, so as to appear a kind of double pericarp; the receptacle, or common globular point of attachment for the florets, is somewhat hairy. There is only one species of the genus known, and exclusively indigenous to the United States and Canada; it bears entire leaves by 2's and 3's, or opposite and ternate, at each joint of the stem. In the southern states there is a variety, with the leaves and branchlets pubescent.

I know no common, prevalent name for our beautiful *Houstonia cœrulea*, which bears low tufts of delicate pale blue cross-shaped flowers, adorning every mossy bank or shorn meadow, and presenting themselves in all directions, like the eyes of Argus; seeming almost as handfulls of pale scattered flowers of the Lilac, which had come too early to maturity. Each little plant, when examined apart, presents a few forked branches of an inch or two in length, and with but a few ovate or egg-shaped leaves, principally clustered round the root. The flower consists of a small 4-cleft calyx; a somewhat funnel-formed, long-tubed corolla, with an elegant 4-lobed border; to this succeeds a half-superior, 2-celled, 2-valved, many-seeded capsule, which opens transversely or across.

The beautiful little evergreen, box-leaved *Mitchella*, or Partridge berry, of our shady woods, is also deserving of particular attention; its branches trail along the ground, and form a small, deep green, shining mat, enlivened, about June and July, with pairs of white, 4-cleft, monopetalous flowers, singularly villous or downy on the upper or inner surface; but the most remarkable character of the genus, of which there is but a single species, is, that by the ingraftment and coalescence of the two germs of each pair

of flowers, only a single scarlet berry is produced, but containing four seeds.

The *Cornus* (Cornel or Dogwood), with which the United States abound in species, are small trees or shrubs bearing flat clusters or cymes of flowers resembling those of the Elder, and commonly white. In the Dog-wood (*Cornus florida*), these small flowers are aggregated into flat heads, like compound flowers, surrounded by an involucrum of four leaves, which gradually grow out, and become of a white color, adding, from the latter end of May to June, one of the greatest and most characteristic vegetable features to our vernal landscape. Examined a little more closely, the minute flowers of the head consist each of a 4-toothed calyx ; and 4 narrow, spreading, pointed petals ; to these succeeds a red drupe, or succulent stone-fruit, inclosing a nut of 2 cells. Almost exactly similar to the arborescent Dog-wood, is the humble Canadian species (*Cornus canadensis*), which runs at the root, and sends up at near intervals, small herbaceous stems four or five inches high, terminating in a tuft of ovate leaves, and a single cluster or head of flowers. This is one of our northern species found amidst bushes, in shady woods, and scarcely differs from a similar species, the *Cornus suecica*, of northern Europe.

One of our earliest flowering plants of this class, belonging to the family of the *Arum*, is the Skunk-cabbage (*Symplocarpus fœtidus*), a fœtid plant, which you will often find in flower on the margins of swamps, in the months of February and March, if sufficiently uncovered by the snow. These flowers, in round naked heads, are defended by a kind of cowl or egg-shaped spathe of the most fantastic and marbled color, in which brown and green predominate. The flowers of the head, each consist pretty obviously of a

calyx of 4 leaves, which persists to the ripening of the fruit, and even continues, after the period of inflorescence, still to increase with the enlarging spadix. There are no petals, and each pyramidal style is succeeded at its base by a single seed, large as a pea, not forming a berry, as in the *Arum triphyllum*, or Indian Turnip, but *immersed* in the spongy mass of the common receptacle.

To the second order, or DIGYNIA, of this class, belongs the curious, common shrub, called Witch-hazel in this country, from its resemblance to the Hazel, the *Hamamelis*, of Botanists. Its time of flowering, October to November, when almost every flower else, but the lingering Asters, are faded and gone, is, for a shrub, sufficiently singular; when this takes place, the leaves of the plant are daily falling, and on a few but naked branches are its pale yellow, fringe-like, clustered blossoms developed. The flowers grow commonly by threes, with a little involucrum of three bractes at their base; the calyx is 4-cleft; the petals, at first rolled up like a piece of tape, are unusually long and narrow; to these, in the course of the following season, succeed a kind of leathery, 2-horned, 2-celled nuts, at length, cleft at the top, with one elastically coated black seed in each cell.

The Pond-weeds (*Potamogeton*) belong to the fourth order, TETRAGYNIA, as well as the fourth class, and, indeed, have every thing by fours; a 4-leaved calyx; no corolla; to each flower succeeds 4 one-seeded nuts. These plants have commonly floating or immersed leaves of an olivaceous green, and thin texture; when immersed, the flowers themselves are of the same dingy green and inconspicuous hue as the leaves. Nearly allied to this genus is the *Ruppia maritima*, found on almost every sea-coast

in the world, growing in great quantities together, and its narrow, thin, and immersed leaves affording food for flocks of sea-birds. In this plant there is neither calyx nor corolla, but each set of anthers and styles is succeeded by four pedicellated seeds.

CHAPTER XV.

THE CLASS PENTANDRIA.

More than one fourth of the vegetable kingdom produce flowers with five stamens, either free, or combined together, as in Syngenesia. But the present class professes to include, alone, such plants as have 5 separate stamens; and this symmetry of the number 5, which obtains even in the lowest order of the animal kingdom, among the zoophytes, such as the star-fish, and sea-egg, prevails equally through every other subordinate part of the flower, except the style, and some of the fruits. The calyx and corolla will be found almost universally quinquifid, and the fruit, not unfrequently, 5-celled, 5-valved, or 5-parted, though by a kind of constant and hereditary abortion, or abridgment, this number in the parts of the fruit is often reduced to an apparent unit. In the case of all fruits, however it may be with the other parts of the flower, there are strong reasons, as will appear more apparent in the sequel of our examinations, to believe, that when consisting of more than one cell or one valve, their number is only augmented by portions, more or less distinct, of several ingrafted or coalescing single-celled, and single-valved pericarps. Spontaneous and hereditary ingraftment by approach, and obliteration and abortion of parts for want of equal room and nourishment, are the obvious causes of most

of those aberrations from symmetry which might be presupposed to exist in union with the other developed parts of the flower. Of this rule, as operating on the number of pericarps, we have no bad example in the ASPERIFOLIÆ or Rough-leaved plants, of which we shall immediately treat, for here we have, in fact, for fruit, 4 one-seeded, naked, and distinct pericarps succeeding to each flower; and on the confines of this order, in *Phacelia*, a coalescence of these pericarps so as to form but a single 4-celled, 4-seeded capsule. The consistence of the pericarp and its integuments produce differences which, viewed apart, seem more important than they really are; for example, the bony integument of the fruit of the ASPERIFOLIÆ entitles its pericarp to the name of a nut; and such integuments are, as may be supposed from their hardness and unyielding texture, extremely prone to promote the abortion of every thing imprisoned within their walls. On the contrary, the pericarp in the Gooseberry and Currant, becoming filled with a soft and yielding pulp, constitutes a berry, and is a consistence of the pericarp extremely favorable to the production and perfection of the inclosed seeds. Dry capsules or cases, if not of too hard a texture, also yield to the growing seeds, and are very fertile. The Apple, distinct as it appears as a fruit, differs only from an ordinary capsule, in the accumulation of cellular juicy matter within the integuments of the lower part of the calyx. The berry of the Strawberry is only produced by the succulent enlargement of the receptacle; and, in this respect alone, differs from the genus *Potentilla*, which has dry seeds seated on a juiceless receptacle. But it is unnecessary to multiply examples of these curious, but little i portant, changes which prevail in the vegetable kingdom, and

mask to ordinary observers the real affinities and true relations which plants bear to each other.

In the present artificial and enormous class, the importance of classifying plants by their natural characters, rather than by the unimportant coincidence in their number of stamens, becomes quite obvious ; and we shall, accordingly, select a few examples of natural groups in the first order of Pentandria. At the commencement of the class you will find the group long known by the name of ASPERIFOLIÆ, or Rough-leaved plants, a character obvious enough in most of the tribe ; but they will be more certainly known by the character they have, in common with the Labiate plants, of producing 4 naked seeds, or rather, bony, single-seeded pericarps in the bottom of the calyx. They have likewise a monopetalous corolla of five equal divisions ; except in *Echium*, where there is an evident ringency, approaching by a shade, to the Labiate character. In some genera the corolla has its orifice closed or hidden by five projections or indentions which cover the stamens. The plants themselves have rough and undivided leaves, set in alternate order along the stem, the summit of which presents spikes or racemes of flowers, before developement coiled inward, but, in time, lengthening out, and becoming straight and forked flower-branches.

To this tribe, though the common American species presents a remarkable exception in the perfect smoothness of its leaves, belongs the Lungwort, or *Pulmonaria*. The Virginian species (*Pulmonaria virginica*), occurs pretty commonly in the shady woods of Pennsylvania, and most other of the southern and western states ; its flowers, which appear in May, look like so many small, bright blue, pendulous funnels, internally open at the orifice, after the manner of the genus, each springing out of a prismatic, pentagonal, 5-

toothed calyx; the seeds, also, unlike *Anchusa*, are imperforate or without hollows at the base, and are smooth on the surface.

The *Echium*, or Viper's-bugloss, so called in allusion to the style, which looks like the forked tongue of a snake, is here better known, at least, in Virginia and Pennsylvania, by the name of Blueweed, as when in flower, which is almost throughout the summer, its blue and abundant blossoms form a striking feature to every observer. In this genus the calyx will be found divided into 5 narrow segments; and the corolla almost entirely open, and naked of scales, somewhat resembles a bell with an unequally 5-lobed border, of which the lower segment is acute and reflected. The stamens and style are conspicuously exerted or stretched out, and the stigma forked; the seeds present a tubercular surface, and are imperforate.

In *Myosotis*, Mouse-ear, or Scorpion-grass, the latter name from its ancient reputed virtues, and which you will find common by the margins of springs, the corolla has the form of a salver, with the border divided into 5 very obtuse shallow lobes, with its stamens entirely hidden by 5 projecting bodies which close up the opening of the tube of the corolla; the seeds are naked, and, as in all the rest of the preceding genera, fixed merely to the bottom of the calyx, an arrangement which you will find very different in the

Cynoglossum, Hound's-tongue, and *Rochelia*, both, till very lately, species of one genus, differing chiefly in their seeds, which are even, and flattened down into hollows in the Hound's-tongue; but prickly or very rough, and simply flattened, in Rochelia; but in both, the seeds are fixed to a distinct central column or receptacle; the corolla in each is closed, as in *Myosotis*, by 5 obtuse projections, short and funnel-form also in *Cynoglossum*, but salver-formed in *Rochelia*.

The common species, *R. virginiana* (formerly *Cynoglossum*), is a common, unsightly weed, with very small white flowers; oblong-lanceolate and acuminate leaves, scabrous on the upper surface; the flower-branches spreading; and the pericarps so densely covered with hooked prickles as too readily to adhere to the fleeces of sheep, and become inextricable when attached.

Our next natural group shall be the Lysimachiæ, the genus *Lysimachia*, or Loose-strife, being the type of comparison, and a genus of which you will hardly fail to meet with some species or other, however limited may be your excursions. The character of the genus is to have a 5-cleft calyx, a rotate, or wheel-shaped corolla, inclining, in some species, to be campanulate, with a 5-cleft, sharp pointed border; and a capsule of 1 cell, with an opening, according to the species, by 5 or 10 valves. In some species the stamens have their filaments of unequal length, and below united into a short tube, so as to appear monadelphous; in others, as the *L. ciliata*, the stamens are equal, disunited, and furnished with the imperfect rudiments of five other filaments, in the form of so many intermediate dentures; and, in fact, in the *L. thyrsiflora* of America, the corolla itself is often 6 to 7 parted, with 6 or 7 perfect stamens, thus making a still nearer approach to the symmetrical number 10, indicated in the structure of some of the other species. The most common species, in low grounds, is the *L. ciliata*, known by its oppositely situated, long petiolated leaves, of a form betwixt cordate and ovate, with an acuminated point, and particularly by the row of long hairs, resembling the *cilium* or eye lash, arranged on either side the petiole. The flowers come out by pairs, and nod or turn downwards.

In the same family of the Lysimachiæ you will

find a rather common, and very humble, but beautiful garden-weed, the Pimpernel, Red-Chickweed, or Poor-man's Weather-glass (*Anagallis arvensis*), it scarcely differs from the preceding genus in any thing but the dehiscence of the capsule, which is globose, one-celled, and many-seeded; and instead of longitudinal valves, opens transversely all round into 2 pretty equal cups or hemispheres; the common kind is a low annual plant, trailing or procumbent on the ground, with opposite, sitting, ovate leaves; and axillary, solitary, or singly disposed flowers, of a pretty scarlet color, never open but in the sunshine of a fine day, and closing at the approach of storm and darkness. There is another kind, occasionally cultivated, with flowers of as bright a blue as the others are scarlet.

Another well known family of this class is the CONVOLVULI, of which the Bindweed, or *Convolvulus*, is the principal genus. They derive their name from their slender twining stems, and are among the more common plants which we cultivate, as well as wild in our bushy and rich woods. They are known, at once, by the large, somewhat bell-shaped, and plaited corolla, which before and after opening resembles a twisted cone; the border is almost equal, though a division into 5 superficial lobes is not unapparent, and indeed, quite obvious in the Cypress-vine, or *Quamoclit*, of the following, and once united genus *Ipomœa*. The calyx is 5-parted, and either naked at the base, or subtended by 2 bractes, which last character, with some others not sufficiently apparent, have led some botanists still further to divide the old genus of *Convolvulus*. There are 2 stigmas, but only 1 in *Ipomœa*; a capsule of 2 or 3 cells, with the same number of valves, and each cell containing 1 or 2 seeds. Their flowers only open in the morning sunshine, and wither by noon. The *purple* Bind-

weed has rough heart-shaped leaves; 2 or 3 flowers on a peduncle, commonly of a fine purple, though sometimes red, bluish, and white, with five purple lines. The *tricolor* Bindweed, (*C. tricolor*) grows low and prostrate, but does not twine, having smooth, oblong lance-shaped leaves; singly disposed, or solitary flowers in the bosom or axil of the leaves; the corolla is of a beautiful bright blue, with a white eye, or centre edged with yellow.

Nearly allied to the preceding group is the natural order of the Polemonia, from *Polemonium*, its type, of which the moist shady woods of the United States affords a single species. The principal character of this group is the ternate division of the stigma and capsule. In the *Polemonium* or Jacob's-Ladder, as it is called in Europe, from its pinnately cleft leaves, the calyx is campanulate, with a 5-cleft border; the corolla also campanulate, with a 4 or 5-lobed erect border, and having its short tube closed up by five staminiferous valves. The stigma, as in the whole order, trifid; the capsule roundish, of 3 cells, each cell many-seeded; the seeds oblong, and somewhat triangular. Besides the *P. reptans*, which is a native of the middle and western states, we sometimes find in gardens, the *P. cœruleum* of Europe, like our own, bearing blue flowers, and now and then occurring, like most other plants, with those that are white.

But the most common plant, in all our woods and meadows, of this natural order, is the *Phlox*, of which we have many species, and all of them not unaptly resembling Pinks, except in their having a monopetalous corolla. These have a small deeply 5-cleft calyx; a very conspicuous bluish or purplish, flat, salver-shaped corolla, with 5 inversely wedge-shaped lobes, and a conspicuous tube more or less curved, which irregularity also operates on the disposition of

the stamens, being so many mere anthers situated, in two different though contiguous parts of the tube. The capsule resembles that of the *Polemonium,* but differs in producing only a single seed in each of the three cells of which it consists. The seeds are also oblong, and, following the contours of the round capsule, without angles.

Another splendid genus of this family, altogether American, is the *Cantua* or *Ipomopsis* of Michaux. These are chiefly biennials, with finely divided, or rather pinnately dissected, alternate leaves, (those of Phlox being entire and opposite.) The calyx resembles that of *Phlox*, but more membranaceous ; the corolla has a long, straight tube, and pointed, lobed border; the capsule has many angular seeds in each of its 3 cells. The *Cantua coronopifolia*, in its leaves and flowers so much resembling the *Ipomœa quamoclit*, or Cypress-vine, is perhaps the most splendid and elegant plant which the United States can boast. The flowers are numerous, resembling so many clustered little scarlet trumpets, spotted with the richest carmine, and all inclined to a single side of the erect stem, crowded below with leaves as fine as hairs. Besides this better known species of the sandy woods of the Carolinas, there are in the southwestern wilds of the United States, up to the foot of the Rocky Mountains, four or five other species of great beauty, but as yet scarcely known to botanists.

Another tribe of Pentandria deserving particular attention is the order Solaneæ, of which *Solanum*, the genus of the common potatoe, is the type. In this genus the calyx has 5 or 10 persisting divisions ; a rotate corolla of one piece, commonly divided into 5 lobes on the border. The anthers connive together in the form of a cone, are of an oblong form, and have the peculiarity of opening merely at the top by two

terminal perforations, instead of longitudinally, as is the usual manner of the dehiscence of anthers; the berry, which succeeds, is divided into from 2 to 5 cells. The genus is extremely numerous, and most of the species belong to South America. The Potatoe (*Solanum tuberosum*) was introduced into Europe from the mountains of Peru, and has become infinitely more valuable, as an article of food, in the colder regions of Europe and North America, than it could ever have been in its native climate. It is with us an annual, perishing after the ripening of its numerous tubers or roots, which are, in reality, only so many short and succulent running branches, readily capable of growth when divided into eyes, or single buds.

The Ground-cherry (*Physalis*) scarcely differs from *Solanum*, except in the calyx, which at length becomes inflated like a bladder, and incloses the 2-celled berry, when ripe becoming yellow, pleasantly acid, palatable, and wholesome in all the American species, though the European kind called *Alkekengi*, is considered a poison.

We have commonly in gardens, and almost a weed, another genus, called *Nicandra*, having blue flowers somewhat bell-shaped, merely differing from *Physalis*, in having a dry berry, but likewise inclosed by the inflated calyx.

The *Datura*, or Thorn-Apple, called also James'-town-weed, is another genus of the family SOLANEÆ. It bears a tubular, angular, and deciduous calyx, of which the orbicular and enlarging base is alone persistent. The corolla is plaited, and when expanded, funnel-form. The thorny capsule is ovate, 2-celled, 4-valved, with the cells 2-parted. This is a common fœtid and poisonous annual, too abundant in every waste and neglected garden, expanding its flowers only in the evening. There are several other species

besides the *D. stramonium*, natives of South America, and India.

The Tobacco (*Nicotiana*) belongs equally to this tribe, and bears a tubular 5-cleft calyx; a funnel-form corolla, with a plaited, 5-cleft border; the stamina inclined; the stigma capitate; the capsule 2-celled, and 2 to 4-valved. Nearly related to this almost exclusively South American genus of narcotics, is the

Henbane (*Hyoscyamus*) of Europe, differing principally in the irregularity of its 5-lobed, funnel formed corolla, and the singular opening of its 2-celled capsule, which is by a transverse valve or lid, like that of a box. The whole plant in the common species, *H. niger*, has the heavy smell and viscid pubescence of green Tobacco, and is still more powerfully narcotic. The corolla is yellowish, and elegantly spotted with dull purple.

Another interesting and common tribe of Pentandria is the Caprifolia, from *Caprifolium*, its type, our commonly cultivated coral Honeysuckle, which is, however, perfectly wild and indigenous from Cape Henlopen, in Delaware, to an interminable distance south, generally trailing amidst bushes, and almost evergreen in the Carolinas. In this genus, scarcely distinct from *Lonicera*, or the true Honeysuckle, the calyx, which crowns the germ of the berry, is very small and 5-toothed; the tube of the corolla long, the border 5-cleft and equal, but in the true *Lonicera* unequal, or in 2 lips; the stamina are exserted; the stigma round, the berries distinct from each other, 3-celled, and many-seeded, but in

Xylosteum the flowers grow by pairs on the summit of the same peduncle; the corolla, as in the Honeysuckle, to which this genus was formerly joined, presents often a deviation from regularity in the outline;

and the berries grow by pairs more or less distinctly united together, each having 2 cells and many seeds.

In *Symphoria*, formerly also included in *Lonicera*, the minute calyx is only 4-toothed, and, as in the preceding genus, furnished with 2 small bractes at its base. The corolla is small, partly campanulate, with a 5-cleft, nearly equal border. The berry is crowned with the persistent calyx, and is divisible into 4 cells, with only 4 seeds, and 2 of the cells are often abortive. The most singular and ornamental shrub of this genus is the Snowberry (*S. racemosa*), which in the autumn, appears loaded with a profusion of snow-white or wax-like berries in clusters, adding to the plant a singular beauty, of which the inconspicuous flowers have not to boast.

The Violet (*Viola*), of which the United States possess more than twenty species, is the type of a very distinct natural order, the Violaceæ. The genus is characterized by having a deeply 5-cleft calyx, produced or projecting at the base. The corolla consists of 5 irregular petals, the upper petal continued backwards in the form of a spur. The anthers are connivent, and slightly cohering. The capsule is conic, of 1 cell, spontaneously divisible into 3 valves, the seeds adhering to the centre of the valves. The species are very naturally divisible into 2 sections; those which are stemless and produce their flowers immediately from the root; and those which have stems and flowers in their axils or the junction of the leaf and stem.

CHAPTER XVI.

OF THE OTHER ORDERS OF THE CLASS PENTANDRIA.

We shall commence the second order of the fifth class by presenting you with the natural family of the Apocineæ, so called from *Apocynum*, its type, known by the various names of Dog's-bane, Catch-fly, and Indian Hemp. Two species are with us common, upright, and somewhat branching, milky juiced plants, found in sandy fields, and amidst bushy open woods; their stems are extremely tough, and afford a durable flax or hemp, but in a quantity perhaps too small to deserve cultivation. The anthers of the flower, which are arrow-shaped, connive together into a cone, and firmly cohere to the columnar stigma about their middle; within, and below these anthers is situated the secreting nectariferous cavity. Flies attempting to rifle this reservoir, by inserting the proboscis between the interstices of the anthers, become cruelly imprisoned, and held till dead, by that organ of their nutrition, which, once exserted, and shifted a little upwards, can then be no longer retracted; and the poor insect, like Tantalus, with plenty in view, but out of reach, perishes of want. That you may find this plant and its congeners, attend to the following characters. They have a very small 5-cleft calyx; a campanulate (white or rose-colored, veined) corolla, the border with 5 short, spreading or revolute lobes; the anthers are already described. There are also 5 *glandular* acute teeth, alternating with the stamens, and opposite to the segments of the corolla. The species are very similar, so that it is somewhat difficult to distinguish them from each other; but with these specific characters we have not here room to interfere, and refer you rather

to the local or general floras or descriptions of plants, with which you are, probably, already provided.

The ASCLEPIADEÆ, nearly allied to the preceding order, shall be our next natural family of the fifth class, and second order; and here, if you examine closely, you will probably find a difficulty in making out either what are the stamens or the pistils, so different is the arrangement and consistence of these parts in *Asclepias*, Swallow-wort, or Silk-weed, from those of most other plants; and we confess, that, but for their relation with the decidedly pentandrous *Apocynum*, we should certainly place this genus in GYNANDRIA, its genuine artificial station.

In this genus the calyx is also very small, and 5-parted; the corolla rotate, 5-parted, and reflected backwards from its first opening. The next set of organs, which now present themselves, are not the stamens, as usual; you will, at once, perceive that they are of the nature of an inner corolla. By Linnæus such processes were confounded with the nectary, or secreting honeyed glands of flowers. I ventured to give them the epithet of *lepanthia*, inner scales or petals. In this genus, this process, connected below to the corolla, is divided into 5 parts, each of which is hollow or ear-shaped, sending out from within its base a subulate or awl-shaped averted process, bent towards the summit of the stigma. The anthers are 5 crustaceous bodies, adhering about the middle to the stigma, consisting of so many pairs of cells for the reception of the pollen, which is collected into five pairs of club-shaped, yellow, wax-like, solid masses, suspended from the 5 angles of the summit of the stigma; each pair of these pollen masses has not, however, a corresponding set of antheroid cells for their reception, but each pair passes into the contiguous cavities of 2 pair of the receiving cells. But

one stigma also is visible, though beneath it will be found 2 germs united in a common base, which, at length, become 2 soft, conic capsules, called *follicles*, each of which, according to the nature of that very simple pericarp, consists of only one cell and one valve folded together concavely, and opening lengthwise by a suture. The seeds, flat, and imbricated or tiled over each other, and terminated by a coma or long silky crown, are attached to a depending furrowed receptacle, the coma being the umbilical cord or attaching string of the seed, and at length, its buoyant crown ready to waft or launch it in the air, and carry it almost to any distance, as a new germ of vegetable colonization. The larger flowered species of Asclepias, such as the *A. syriaca* or Silk-weed, and *A. tuberosa* or Butterfly-weed, act also as catch-flies, the insects getting entangled by the feet in the chinks of the contiguous antheroid cells, and remain prisoners till they perish with hunger and fatigue. To suppose these plants peculiarly possessed of a carnivorous appetite, instead of a structure accidentally fatal to some insects, as in the case also of so many glutinous plants and flowers, is devoid of all evidence, and only one of those unsupported interpretations of the operations of nature which would limit every idea to our contracted views of general utility. More than 20 species of *Asclepias* are indigenous to the United States. They have very generally a milky sap, which, like that of the *Apocynum*, partakes, when inspissated, of the nature of gum-elastic. Some of the species are among our most common productions, particularly the red-flowered swamp species, *A. incarnata*, and the *A. syriaca*, or common Silk-weed, growing so abundantly along the rich margins of streams. The silky down of the seed of this last species has been manufactured, and the fibres of the stem afford a durable flax. The *A.*

tuberosa of the sandy fields of the southern and middle states bears, in August, a profusion of bright orange colored flowers, alternate leaves, tuberous roots, and is destitute of milky sap.

In botanizing in the middle and southern states you will probably meet, occasionally, with fœtid, twining plants producing umbels of brown or greenish flowers, nearly resembling those of *Asclepias*, but without awns in the lepanthium or nectary; these will belong, probably, to the genus *Gonolobus* or *Cynanchum*. They likewise produce follicles, and comose seeds, and strictly belong to the Asclepiadeæ.

Late in autumn, when few other flowers are visible, you will still meet in wet places with a set of very rich blue-flowered plants of a bitter taste, belonging to the second order of Pentandria, of the genus *Gentiana* or Gentian, a bitter medicinal drug, and the type of a natural family of similar name. The calyx is 4 or 5-parted; the corolla partly campanulate, but tubular at the base, having a 4 or 5-cleft border, with its edge, in some species, fringed, and, though commonly expanding, sometimes almost shut up, as in our common *G. saponaria*, where the corolla is so closed as to look like a barrel. The stamina are included or inclosed. The stigmas 2. The capsule 1-celled, 2-valved, containing very many minute seeds attached to 2 longitudinal receptacles.

To the same natural family Gentianæ, but without much reason placed in the first order of Pentandria, appertains the American Centaury (*Sabbatia*), the common and beautiful ornament of our open, swampy, natural meadows and saline marshes, with pink red or white flowers, having a particolored star in the centre. According to the species, the calyx as well as the corolla is 5 to 12-parted, the latter quite open or rotate, and so readily distinguished

from the tubular campanulate corolla of the Gentian. There are also two spirally twisted stigmas, and the anthers themselves are, at length, revolute. The capsule, as in Gentian, 1-celled and 2-valved. All these plants have the medicinal bitter resin of the Gentian, grow low, have opposite, entire smooth leaves, and flowers in terminal or flat clusters or corymbs.

The *Umbelliferous* plants, of which we have elsewhere already spoken, find place also in the second order of this artificial class. There is a difficulty in distinguishing the genera in this tribe, common, more or less, to every very natural group, for the numerous links which connect the whole order so closely together, at the same time diminish the minor distinctions of the genera. In the UMBELLIFERÆ, so intimate is this general resemblance, that but little remains for generic distinction, save the form of the pericarp, which is, indeed, very distinct in many genera; as, for example, it is round, flattened, and nearly naked in the Parsnip: of an oblong, roundish form, with five ribs, armed with prickles in the Carrot (*Daucus*): ovate and solid (or not coated), with 5 ribs, at first crenulate or waved, in the Hemlock (*Conium*): the fruit narrow, pyramidal, rostrate, and sharply 5-ridged in the *Myrrhis* (or American Chervil): the umbel simple, and the leaves undivided in *Hydrocotyle*, Water-rot, or Marsh Pennywort,* and the fruit roundish, but compressed in a reverse sense with that of the Parsnip, and each seed backed with three ribs. In the Sanicle (*Sanicula*) the umbel is also nearly simple, the flowers crowded, and of different sexes, with a distinct 5-parted calyx, which is persistent, and an oblong,

* So called, in allusion to the round peltate form of the leaves in many of the common species.

solid, unribbed fruit, closely armed with hooked bristles. In the *Eryngium*, or Sea-holly, generally spiny plants, with blue flowers and bractes, the flowers grow in dense, roundish heads, upon a chaff-bearing receptacle, and have a many-leaved, more or less spiny, involucrum.

And though the mutual distinctions which mark the genera are not all so obvious as those above selected, a due attention to the fixed characters of the fruit, taken sometimes in conjunction with the involucrum, and other lesser traits, will, on the whole, prove sufficient to remove ambiguity, and bring you sufficiently acquainted with this remarkable tribe of plants, of which so many are poisons to men and cattle, and so few are either useful or ornamental. Among those which we cultivate, are the Parsley and Cellery, Carrot, Parsnip, Skerret, Caraway, Coriander, Fennel, and Chervil (*Scandix cerefolium*). The Earth-nut (*Bunias bulbocastanum*) of Europe, though not cultivated, is often eaten by children, and may be considered harmless. The large tuberous roots of the *Arecacha*, an umbelliferous plant of South America, belonging to the genus *Conium*, or Hemlock, are also eaten, and esteemed as but little inferior, either in quantity or quality, to the common Potatoe. From the *Ferula Assafœtida* of Persia, is obtained the gum and drug of that name. The Lovage and Angelica were formerly in repute as domestic medicines.

To the third order of Pentandria belongs the Elder (*Sambucus*), having the flowers disposed in that kind of flat cluster, termed a cyme. The calyx is minute, and 5-cleft. The corolla nearly rotate, 5-cleft. Stigmas minute; the berry globular, 1-celled, and 3-seeded.

The *Viburnum*, also appertaining to the Caprifolia tribe, differs from the Elder in bearing, for its

3 stigmas, an oblong berry, or rather drupe, in many of the species containing only 1 seed. In the Viburnum shrubs, too, the leaves, though sometimes lobed, as in the Cranberry-tree (*V. oxycoccus*), are never compounded, as in the Elder. Among the foreign species of this genus, best known to us, is the early flowering *Laurustinus*.

The Sumach, or *Rhus*, of the TEREBINTACEÆ, though placed here, has many species with dioicous flowers. They are all shrubs, or small trees, many with a milky sap, and some with an aromatic odor; they have ternate or pinnated leaves; inconspicuous greenish flowers, in terminal conic clusters. The flowers are inferior, with a 5-parted calyx. 5 petals; a small, dryish, and flattish berry, often red, and then acid, or white and poisonous, including one hardish seed, or nut. The most common, creeping, and scandent kind, called Poison-vine, has ternate, entire, or coarsely-toothed leaves, and clusters of whitish berries. This species is, however, less venomous than the Poison-ash, or Dogwood of New England (*R. vernix*), which grows always in dark swamps, is very smooth, with pinnate leaves in many pairs, and naked, reddish petioles, the leaflets oval, entire, and acuminated, the panicle loose, the flowers dioicous, and the berries nearly white.

To PENTANDRIA TETRAGYNIA, but to no certain natural order, without it may be considered as an order as well as genus apart, belongs the *Parnassia*, or Grass of Parnassus. Their white, solitary, beautifully veined flowers may be observed in August and September in considerable abundance, in the low, marshy meadows of the New England states and Canada, but chiefly in mountain meadows, and near boggy springs in the southern states. Each stem is embraced by a single leaf below its middle, and pro-

duces only a single flower with the aspect of a *Ranunculus*, or Butter-cup. The calyx is 5-parted and persistent. The petals 5, and inferior. There are 5 cordate lepanthia or nectaries, arising from the claws of the petals, each edged with a variable number of hairs terminated by globular glands. Stigmas 4. Capsule 1-celled, 4-valved, the valves bearing imperfect partitions in the middle. The seeds, with a membranaceous margin. There appears to be some affinity betwixt this genus and *Passiflora*, but the seeds and lepanthia are still very different, and would not justify its situation in the same natural family.

In the 5th order, of the 5th class, you will find the Flax (*Linum*) of the natural family Lineæ, itself the type. The calyx is deeply 5-parted and persistent. Petals 5, unguiculate. The filaments of the stamina are united at the base. The capsule superior, nearly globular, 10-valved, and 10-celled. A single ovate, compressed seed in each cell. The flowers are either blue or yellow, and some of the species afford those cortical fibres, which we call Flax. In nearly all the species, the leaves are narrow, alternate, and entire. The Virginian species (*L. virginianum*), a pretty common perennial, in the middle states, has small, yellow, remotely situated flowers. The perennial Flax of Europe (*Linum perenne*), with blue flowers, like the cultivated species, is met with on the banks of the Missouri.

The *Aralia* (two of the native species called Spikenard and Angelica-tree), of the natural order Araliæ, nearly allied to the umbelliferous tribe, belongs also to the 5th order of this class. They are either low or stout herbs or shrubs; the *A. spinosa* becomes almost a tree, and has its stem and branches covered with sharp thorns. The flowers, small and white,

are disposed in numerous white umbels. The calyx is 5-toothed, and superior; the petals 5. The stigmas partly globose. The fruit a 5-celled, 5-seeded berry.

To the singular classification of Pentandria polygynia is referred the *Xanthorhiza*, or Yellow Root of the mountains of Carolina. But as it belongs to the natural order Ranunculaceæ, we may properly consider it as a plant of an irregular number of stamens, and related to Polyandria. It is a very low running undershrub, with a yellow root, occasionally used in dying, having bipinnate, Parsley-looking leaves, and brown, small flowers, disposed in compound racemes. There is no calyx; 5 petals; and 5 obovate, pedicellate lepanthia, or petaloid nectaries. Each flower is succeeded by from 5 to 8, 1-seeded, half 2-valved capsules.

CHAPTER XVII.

THE CLASS HEXANDRIA.

In this artificial class will be found a very natural, though varied assemblage of plants, of which some are closely related to others of the third class, the numbers 3 and 6 having a symmetrical ratio to each other, and are indicative of one of those grand distinctions in the vegetable kingdom, which separate them into primary or principal divisions; most of the plants of Hexandria, with the exception of a few shrubs, appertaining to the great *monocotyledonous* class of the natural method.

With the liliaceous tribe you are already generally acquainted. The Lily itself presents two sections in the form of the corolla, which is composed of 6

petals inclining to the campanulate form, and without calyx, the 3 outer petals seeming to answer that purpose, the 3 inner are marked with a longitudinal channelled line, the base of which is nectariferous. In the common orange, white, and Philadelphian Lily the corolla forms an erect cup; but in the Martagon, Tiger, Canadian, and Superb Lily (*L. superbum*), the petals are so reflected, as to put on almost the appearance of a turban. The stamina are shorter than the style, and the stigma entire. The capsule is superior, and 3-sided, with 3 cells and 3 valves, the valves connected, even after opening, by cancellate or crossing hairs. The seeds are flat and triangular, arranged in 6 rows. The United States affords five or six species of this splendid genus. They generally affect low and rich meadows, or fertile shady woods, and thickets.

The Tulip differs chiefly from the Lily in the absence of a style, the triangular germ being crowned only by a trifid stigma. The corolla is bell-shaped, when open like a Lily, but has none of the nectariferous grooves, and is always more swelled or ventricose towards the base; 1 or 2 embracing lanceolate leaves, too, with but a single flower on a stem, and that extremely subject to variation by culture, at once distinguish the Tulip from the Lily. There are several species of this vernal queen of flowers and favorite of the florists, of which the Yellow European (*Tulipa sylvestris*, Eng. Bot. t. 63,) and Van Thol or *T. suaveolens*, are sensibly fragrant. But the later flowering, and more splendid species, *T. gesneriana*, is the most remarkable for the variety and beauty of its colors. This particolored hue, brought to such perfection in Holland, is, however, natural to this species, in a lesser degree, even in its native plains of the East.

Somewhat related to the Tulip, in general aspect,

is the genus *Erythronium*, or Dog's-tooth Violet, the latter appellation seemingly derived from the oblong and slender form of the bulb, somewhat resembling the canine tooth. The corolla is of 6 petals, and partly campanulate, but the petals are reflected, as in the Martagon Lily, though only during the shining of the sun. The interior petals have a tooth-like, thickish process, on either side, near their base, and a honeyed pore. The style is club-shaped, and the stigma entire, or 3-cleft. The capsule is superior, partly stipitate or pedicellate; and the seeds, instead of triangular, are ovate. They are all early vernal plants. We have two or three species, the most common, with yellow flowers (*E. americanum*, Curt. Mag. t. 1113), appearing in moist and shady places, amidst thickets, growing together in extensive clusters, though but few bulbs flowering at a time, and those that do, sending up 2 lanceolate, brown, blotched leaves, and a low scape with a single nodding flower. The root is a brown, smallish bulb, not unlike that of a Tulip.

In similar situations with the last plant, and flowering nearly about the same early period, you will find frequently some species of the genus *Uvularia*, which might, from its aspect, be called Bellwort; a plant, also, of the Liliaceæ order. The inferior corolla consists of 6 erect petals, with a nectariferous cavity at the base of each. The filaments are very short and adnate, or inseparably adherent to the anthers; the stigma reflected. The capsule about as abroad as long, triangular, 3-celled, 3-valved, each valve with a central dissepiment. The seeds are numerous and partly globular, with an arillus or process at the scar or hilum. They are all low growing, fleshy, fibrous-rooted plants, with elegantly forked, though not much divided, stems, having alternate, oval, or elliptic leaves, and smallish yellow, not well opened,

pendulous flowers. The *U. perfoliata*, a rather common plant, has the elliptic obtuse leaves perfoliate, or as if bored through for the passage of the stem; the corolla campanulate, granular and scabrous within, and the anthers awned. In the *U. grandiflora*, so common in western Pennsylvania, the leaves are also perfoliate, but the petals smooth within, and the anthers bluntly terminated; the flower is also considerably larger. There are likewise 2 other species with which your Floras or systematic books will readily bring you acquainted.

In *Asparagus*, by some assumed as the type of a natural order of the same name, the corolla is inferior and 6-parted. The style very short, with 3 stigmas; and the berry 3-celled, with 2 roundish seeds in each cell.

In *Convallaria*, Solomon's Seal, and Lily of the Valley, which takes its place among the LILIACEÆ, the corolla is inferior and 6-cleft; the berry globular, spotted, and 3-celled. The genus is now divided into several sections, or rather distinct genera or natural groups. In the *C. bifolia*, the corolla lacks a third part of its organs, and is consequently only 4-parted, with the border spreading; the stamens only 4; and the berry 2, instead of 3-celled. The flowers are white and small, in a terminal raceme, and the very low stem furnished with 2 alternate cordate leaves. This plant grows in clusters in shady woods, and flowers in May and June. Here, as in many other instances of well known analogy, we have an example of the natural composition of flowers, formed of so many concomitant parts linked together by perpetual ingraftment, so as to form but one compound individual.

In the next section, *Smilacina*, the corolla is perfect, or 6-parted, and spreading; with the filaments

divergent, and attached to the base of the segments of the corolla. The most common species is the *C. racemosa*, rather a large plant, with broad, plaited, or strongly nerved, sessile, pubescent leaves, and paniculated or compounded racemes of greenish white flowers. This species flowers about June.

The next section, or genus, is the *Polygonatum*, or true Solomon's Seal, which has a 6-cleft, cylindric, unexpanding corolla ; and the filaments attached to the upper part of the tube ; the berry perfect or 3-celled, the cells 2-seeded. These plants have the leaves permanently inclined to 2 sides of the stem ; and the flowers, 2 or more together, growing nearly all the way up the stem in the axil of the leaves. The flowers are greenish white, and appear about June or July. The shoots of the large species, *C. multiflora*, are sometimes eaten as Asparagus.

The earliest harbinger of spring in Europe and the United States,* is the Snowdrop, or *Galanthus nivalis*, belonging also to this showy class of flowers, so finely described by Mrs. Barbauld.

> As nature's breath, by some transforming pow'r,
> Had chang'd an icicle into a flow'r.—
> Its name and hue the scentless plant retains,
> And winter lingers in its icy veins.

It begins often to grow beneath the snow, at a temperature scarcely removed from the freezing point, and flourishes alone, while all other plants lie dormant. The French, in allusion to this remarkable precocity of appearance, term it expressively "*perce-neige.*"

* The small, but elegant flowered, umbelliferous plant, which I hence named *Erigenia* (or harbinger of spring), is about as early as the Snowdrop, flowering in the shady woods of Pennsylvania and Ohio from the 12th to the 20th of March.

Each plant consists of a bulb sending up 2 narrow or linear leaves, from the centre of which arises a scape, terminating in a spathe or sheath, answering the protecting purpose of a calyx. The corolla white, tipped with green, hangs pendulous or drooping, and is situated superiorly with regard to the germ; it consists of 6 petals in 2 ranges, but of 2 different forms, the 3 inner being one half shorter than the 3 outer, and notched or emarginate at their extremities. The Snowdrop is a native of the shady woods and meadows of the south of Europe.

The Daffodil, or *Narcissus*, is the next early flower of this class, which presents itself for our inspection in almost every garden, but being cultivated for show rather than science, the double kind is generally preferred, from which the young botanist can learn nothing of the genus or true character of the flower, the stamina and pistillum, in this case, being transformed, as in other double flowers, into a multiplicity of irregular petals. In this transformation, the filaments of the stamens are enlarged into an additional set of inner petals, and the anthers are destroyed; but, as in the common double Daffodil, there are many more than 6 additional petals, and no pistillum, it appears that the latter organ is, in fact, changed into the monstrous and infertile rudiments of one or more additional flowers. This is very obviously the case in some double Roses, double Wall-flowers, and Stocks, which often present a later flower, or even flower branch, coming out from the centre of a former withered one. The Daffodil, in its natural simple form, unaltered by the luxuriance of the soil, presents from the bosom of a preceding spathe or chaffy sheath, one or more flowers, consisting of a superior corolla of 6 equal petals or parts, and within them an interior, funnel-shaped lepanthium, or nectary of a

single piece, within which are the stamens. The *Polyanthus Narcissus* (*N. tazetta*), and the Jonquil (*N. jonquilla*), so called from its rush-like, narrow leaves, are remarkably fragrant, and bear forcing, or bringing early into flower, in Water-glasses, in the ordinary temperature of a dwelling-room.

The *Agave* or American Aloe, referred to the BROMELIÆ or natural order of the Pine Apple, is a very remarkable genus, of which there is one species growing native in Virginia and the southern states. The corolla, of a greenish color, is superior, erect and tubular, or funnel-form. The stamina are erect, and extend beyond the corolla. The capsule is bluntly triangular and many-seeded. The tardy flowering species, *A. americana*, of Mexico, which in cold climates has been cultivated near a century before flowering, arrives at this state in 6 or 7 years in its native climate, and in the warmth of Sicily. Before this period the plant presents nothing but a perpetually unfolding cone of long, rather narrow, but thick and fleshy leaves, pointed, and beset on their margins with strong thorns. Before flowering, this cone and cluster of leaves attains an enormous bulk and developement, at length, it swells more than usual, the circulation of the sap in the outer leaves becomes visibly retarded, and they put on a shrivelled aspect. At this period, the Mexicans who cultivate this plant which they call *magui*, tap it for the juice with which it now abounds, and many gallons of sap continue for a time to exude from this vegetable fountain. From this liquor, when fermented, is distilled the common spirit drank throughout that country, and when the plant is finally exhausted, its tenaceous and abundant fibres afford a durable hemp or flax. If suffered to flower, it sends up a central scapus 18 to 30 feet high, resembling a huge chandelier with numerous clustered branches, bearing

several thousands of elegant but not showy, greenish yellow flowers, from which slowly drops a shower of honey. With the flowering the energies of the plant become exhausted, and it then perishes, however long it may have previously existed, but at the same time it sends up from the root numerous offsets for the purpose of viviparous propagation.

The *Tradescantia*, or Spider-wort, of the natural family Commelineæ, is a remarkable grass-like looking plant, with fugaceous delicate flowers, coming out in long succession so as to form an umbel, from a terminal sheathing leaf. In the common Virginian species (*T. virginica*), they are of a rich blue, and occasionally white. In this plant there is a green 3-leaved calyx, but consequently only 3 petals. The filaments are remarkably downy, and the hairs of which it consists, when seen through a lens, are jointed like a necklace. The capsule is superior, 3-celled, and many-seeded.

To a very different grand division of the vegetable kingdom, the Dicotyledones, belongs the genus *Berberis* of Hexandria, the type of a peculiar natural order, the Berberideæ. These are shrubs, commonly armed with trifid thorns, having yellow wood, alternate acid leaves, edged with bristles: axillary racemes or corymbs of yellow flowers, succeeded by acid, oblong, 1-celled, 2 to 4-seeded berries. The calyx is yellow like the corolla, of 6 leaves. The petals are also 6, with two glutinous glands situated on each claw. There is no style, and an umbilicate stigma. The stamens of the Barberry are remarkable for their irritability; they recline upon the petals, but on touching the base of the filaments by a pin or straw they instantly start forward to the stigma, and this experiment may be repeated upon the same flower.

The Rice, *Oryza sativa*, belongs, in reality, to the grasses, of which it has all the structure, differing chiefly from other genera, and particularly LEERSIA, in having a double number of stamens; and is remarkable in this class, as belonging to the *second order*. This useful annual is still found, apparently, wild in some parts of India, probably its native country; it prefers wet situations, bears a terminal heavy yellow panicle, or cluster of grain, each of which is inclosed in a persistent, rigid, ribbed husk, either naked or terminated by a long awn. The calyx glume is very small. No plant in the world affords such general sustenance as Rice. It is the prevailing grain of Asia, Africa, and the warmer parts of America, and exported into every part of Europe. It has a remarkable native substitute in the *Zizania*, or Wild Rice of the United States, which also belongs to MONŒCIA HEXANDRIA, and will be noticed hereafter.

In TRIGYNIA we find *Rumex*, the genus of the Dock and Sorrel, of the natural order POLYGONEÆ. The perianth or calyx consists of 6 green leaves without any corolla. The fruit is a triquetrous nut like the seed of buck-wheat, covered by the 2 interior valve-like leaves of the persisting calyx. The stigma is many-cleft. The species are numerous and unsightly, one of the most common, indeed troublesome species throughout the United States, is the *Rumex acetosella* or common Sheep Sorrel, which has leaves formed like the head of a halbert, or hastate.

One of our more curious vernal flowers is the *Trillium*, so called from the prevalence of the number 3 in all the parts of the fructification. It is, in fact, the European Herb Paris, lacking a fourth part throughout its structure, for in that, the number 4 prevails with the same regularity as the ternate quantity in our plant. Clusters of these remarkable plants are

not unfrequently met with in all our shady woods, in flower about the month of May. They have abrupt or præmorse, tuberous, perennial roots; and each plant consists of a low, undivided stem, bearing at its summit 3 broad leaves, from the centre of which arises a single sessile or pedunculated flower of a white or brown color, consisting of a 3-leaved calyx; 3 petals; a sessile, trifid stigma; a superior berry of 3 cells, each cell containing many seeds. This genus, with the exception of one Siberian species, is exclusively North American.

Considerably related to the preceding genus is the *Gyromia*, or Indian Cucumber, which is found also in moist or rich shady woods, in flower about June. The roots are white, oblong tubers, tapering at the extremity, and not unpalatable to the taste, having been once collected for food by the original natives. The stem is about a foot high, or little more, and undivided, about the middle sending off a whorl or circle of entire lanceolate leaves; above these appears a ring of 3 other leaves, surmounted by several small greenish-yellow pedunculated flowers, each consisting of a 6-parted, revolute corolla, and no calyx. The filaments and their anthers distinct; no style; but 3 long, brownish filiform and divaricate stigmas, united at the base. The berry 3-celled, the cells each 5 or 6 seeded; the seeds 3-sided and compressed. Of this genus, allied considerably to the preceding, there is but a single species peculiar to North America. It was formerly referred to the genus *Medeola*, which produces a 3-seeded berry, and is peculiar to the Cape of Good Hope.

To the 4th order of this class, or TETRAGYNIA, is referred a very singular, almost aquatic plant of the middle and southern states, called *Saururus*, which is translated *Lizard's-tail*, in allusion to the appearance

of the spike. It evidently belongs to the same natural family as the Pepper-plant (*Piper*). The roots possess, indeed, a racey aroma and taste, and the whole aspect of the plant is that of some species of Pepper. They grow in considerable clusters, as the root runs, and sends up at short intervals, sparingly forked stems about 18 inches or 2 feet high, clothed not very thickly, with alternate, petiolate, heart-shaped, pointed, entire leaves. The narrow and crowded spikes of white flowers terminate the branches, and are from 3 to 6 inches long, gracefully nodding towards the extremity, and hence the specific name of *cernuus* applied unnecessarily, to this only species of its genus, by Linnæus. The rachis, as well as flowers, are equally yellowish white, and the flowers from their crowded position, irregularity in their number of parts, and imperfection or abridgment of structure, are not very well calculated for the study of an entire novice in botany. All of flower that will be found, is a single scale subtending its cluster of stamens, of which the anthers and filaments are adnate, or form but one continuous body. The capsules, commonly 4 in number, are small, and each contains 1, or rarely 2 seeds.

Alisma, or Water Plantain, holds, at the end of the 6th class, precisely the same relative situation as *Xanthorhiza* did in the 5th, namely, the order Polygynia, and though now made the type of a natural order apart, Alismaceæ, it scarcely differs from the Ranunculaceæ, to which that genus of the 5th class is referred. The Alismas are aquatic plants, with nerved, ovate, or partly heart-shaped leaves, bearing perfect small flowers, in a very compound ternately verticillated panicle. In the perfect character of their flowers, and the small and definite number of their stamens, they differ from the *Sagitaria* or Arrow-leaf. As in that genus, Alisma has a calyx of 3 leaves, 3

petals, and a cluster of minute carpels or capsules, each containing 1 seed, but never spontaneously opening. The flowers appear from July to August.

CHAPTER XVIII.

THE CLASSES HEPTANDRIA, OCTANDRIA, ENNEANDRIA, AND DECANDRIA.

Scarcely any plant but the *Septas* of the Cape of Good Hope affords a genuine example of the 7th class. The *Trientalis*, or Chickweed Wintergreen, common to Europe and North America, though sometimes presenting 7 parts in the flower, for which reason it has been here classed, very commonly shows a division of 6 or 8 parts in the flower. The American species, having narrower and longer leaves than that of Europe, is not uncommon in the shady woods of the northern states, near the roots of trees. It flowers about May and June, has a fleshy fibrous root, and most part of the plant an acid taste. The stem is scarce a span high, unbranched, and terminated by a tuft of lanceolate, acuminated leaves. From the bosom of these arise several filiform peduncles, terminated by elegant small, white, flat, stellated flowers, with 6, 7, or sometimes 8 acuminated parts. The leaves of the calyx and stamens bear the same number, and are equally various. The berry is juiceless, and appears shrunk, consisting of 1 cell with many seeds. It is referred to the natural order Primulaceæ, but has no very obvious affinity with the type of that order.

The *Æsculus*, or Horse-chesnut of Asia, has a better claim to be classed here, than most of the American species of that genus. In both, the calyx is one-leafed, 4 or 5-toothed, and ventricose or swelled. The

corolla, in the Asiatic plant, has 5 unequal, pubescent petals inserted upon the calyx; but in the American species or Pavias, only 4. The capsule, either smooth or prickly, has 3 cells, and each cell one seed, though 2 out of the 3 are commonly abortive. The seeds resemble Chesnuts, but are rounder and bitter. On the Ohio they are said to have been employed successfully as a fish poison, and the farina has been made into starch. They are all trees, or large shrubs with digitate leaves, bearing flowers in compound thyrsoid racemes. In most of the *Pavias* the number of stamens fall short of 7, and in the Asiatic species they probably often exceed that number. Indeed 5 or 10 stamens is the natural number that might be expected from the rest of the conformation of the flower.

In the *Befaria* of Florida, for want of a more definite class, placed in POLYANDRIA, there prevails a very curious combination of septimal parts. The calyx is 7-cleft; the corolla of 7 petals; 14 stamens; and a capsule of 7 cells, with many seeds. But in this instance, as well as the *Septas*, and the exact 12 stamened *Asarum*, which has not the irregularity of number characteristic either of Dodecandria, Polyandria, or Icosandria, it seems quite unnecessary to create for them distinct classes on characters which ought to be merely generic.

OCTANDRIA.

This class is by no means an extensive one, and several of its genera are allied closely to others which find place in DECANDRIA. Among these may be mentioned *Rhexia* of the natural order MELASTOMACEÆ, its type, *Melastoma*, being Decandrous. Most of these plants flowering about midsummer, affect wet places, as the grassy margins of boggy ponds and

swamps. They are herbs, branching only to flower, with opposite, rough-haired, entire, strongly nerved leaves, and flowers in cymes; with rather brilliant red, but fugaceous petals. The calyx is urceolate or urn-shaped, with a 4 or 5-cleft border. The petals 4, inserted near the summit of the calyx. The anthers are incumbent or reclined, attached to the filaments behind, and naked at the base, opening below. The capsule 4-celled, and free in the enlarged base of the calyx. The receptacle crescent-shaped, and pedicellate. The seeds small, and numerous.

The *Œnothera*, or Tree-primrose, of the natural order ONAGRARIÆ, is a genus peculiar to America, of which there are many splendid and curious species in the remote western states and territories of the United States. Their flowers are commonly yellow or white, and all of them vespertine, or opening in the evening after sunset. They will be easily known by their very constant generic character, which consists in a tubular 4-cleft calyx; the segments, though deflected and deciduous, constantly adhere at the points. The petals are 4, and generally large. The stigma 4-cleft; capsule 4-celled, 4-valved. The seeds naked, affixed to a central, 4-sided receptacle.

From this genus *Gaura* is to be distinguished by having commonly 4 ascending petals, and a quadrangular, 1 or few-seeded nut; and Epilobium or Willow-herb bears commonly red flowers, and has the peculiarity of producing downy tufted or comose seeds.

The *Oxycoccus*, or Cranberry, of the order VACCINEÆ, differs principally from the genus *Vaccinium* in the deduction of a 5th part of the organs of the flower having a superior calyx of 4 teeth; a corolla with only 4 parts, the segments linear and revolute. The anthers are connivent into a cone, so long as to appear tubular, and 2-parted, emitting the pollen from the

extremity only, as is the manner of the natural order to which it belongs. The berry is red and acid, containing many seeds. The *O. macrocarpus*, or large-fruited American Cranberry compared with that of Europe, is common in all our mossy bogs. It has trailing wiry branches, and creeping roots; the leaves evergreen, about the size of Thyme, and somewhat thickly scattered. The European species (*O. vulgaris*) is distinguishable from the American, chiefly by having the edges of the leaves turned down; it is also, a smaller plant, with the berries commonly spotted profusely with brown.

The *Dirca*, or Leatherwood, the only North American plant belonging to the natural order THYMELEÆ, is a singular looking, smooth barked, much branched, low shrub, not very uncommon in some of our swampy forests, where it flowers as early as April, and that too, like the Mezereon of the same natural family, before the expansion of the leaves. The flowers are small and yellowish, coming out by 3's; they have no calyx, and consist of a tubular corolla, with scarcely any thing like a distinct border. The stamina are unequal, and exserted. The berry contains a single seed. The bark of this shrub is so tenaceous, that it is easier to tear off a branch down to the root than from the stem.

The *Daphne*, of which the *Mezereon* is a common species, differs from the preceding genus in having a funnel-shaped corolla inclosing the stamens, with the border cut into 4 distinct segments; but there is, as in *Dirca*, no calyx, and a 1-seeded berry. The flowers, which thickly clothe the branches before the expansion of the leaves, are also fragrant, of a red color, and come out by clusters in 3's. This plant is extremely hot and caustic to the taste, particularly the bark of the root, and the berries. Some of the other species are evergreens, and commonly cultivated for

9

the beauty and fragrance of their early flowers. None of the species are natives of America; but the *Dirca*, of which there is but one species, is exclusively so.

The *Tropæolum*, Indian Cress, or *Nasturtium*, referred also to the 8th class, deserves particular attention from the incongruity of its parts with the alleged number of its stamens; as it has an inferior calyx of one piece, but divided into 5, instead of 4 segments, and terminated behind in a spur; the corolla has likewise 5 unequal yellow petals finely pencilled with orange. The fruit is 3 seeds, coated with a wrinkled integument; these, from a similar warmth of taste and flavor, have given to the plant the appellation of Cress, and are employed for pickles. From the number of parts in the flower we should naturally expect 10 stamens, and, in fact, the rudiment or filament of a ninth is not uncommon. From the inequality in the length and situation of the stamens which are fully developed, as in the genus Cassia, it is pretty obvious that a 5th part are deducted by abortion. These plants, originally from Peru, are now become common annuals, though rendered perennial by protection from frost. They bear many long trailing tender branches, with alternate, roundish, target-shaped, or peltate leaves, so formed in consequence of having the petiole attached below the margin of the disk of the leaf, and in this instance nearly in the centre.

The genus *Polygonum*, which includes the Buckwheat plant and some of our most common weeds, such as the Knotgrass, belongs pretty generally to the 3d order of our 8th class, and is itself the type of the very natural order Polygoneæ. In this genus, we again find the incongruity of a 5-parted petaloid, inferior perianth, instead of a division into 4, to agree with the assumed number of 8 stamens. The fruit is, as in Buckwheat,

a 1-seeded, and mostly, angular nut. The stamens, however, according to the species, are either 5, 6, 7, or 8. In the *P. virginianum*, indeed, the flowers are only 4-cleft, have but 5 stamens, and 2 styles. But what the nature and extent of abortion is in this genus is not quite so certain as in *Tropæolum*, for in our next genus, of this same natural order POLYGONEÆ, belonging to

ENNEANDRIA

Rheum, or Rhubarb, and also of the 3d artificial order TRIGYNIA, the perianth, for there is but the one floral envelope, is divided into 6 divisions, with the 9 stamens disposed in 2 series, of 6 and 3. The fruit is, also, a triangular, thin nut, with winged margins. In all the species, the leaves, resembling those of the Dock, are very large and heart-shaped, and the thick petioles of one species (*R. rhaponticum*) are commonly cultivated for pies. The *Rheum palmatum*, or medicinal Rhubarb, has scarcely any thing of an acid taste, and palmated or 5-pointed leaves. Nearly allied to this genus is the

Eriogonum of the southern and western states, as far as the Rocky Mountains. These have all small, downy, oblong leaves, in radical clusters, or whorls; and the flowers whitish or yellow, disposed in umbels, each partial cluster is surrounded by an inversely conic cup, or involucrum. The flowers themselves are those of Rhubarb, but downy, being 6-parted, the stamens also 9; but the triangular seed or nut, like that of Buckwheat, though narrower, is destitute of the winged margins the seeds of the Rhubarb.

Another remarkable genus of shrubs and trees belonging to the 9th class is *Laurus*, having mostly a 6-parted calyx; a nectary consisting of 3 glands sur-

rounding the germ, each of them sending out 2 bristles. The stamina 12, 6 of them interior, and 3 of them sterile, bearing glands. Most of the United States species are dioicous or polygamous, have a 6-parted calyx, and no nectary; 9 fertile stamens, the anthers mostly 4-celled, the 6 exterior naked; the 3 interior augmented by 6 infertile ones, bearing glands instead of anthers. The berry is 1-seeded; and in these the leaves are deciduous. The most remarkable species of this subgenus (EUOSMUS) is the *Sassafras* tree, which about April will be found crowded with clustered dioicous flowers, making their appearance earlier than the leaves; the leaves are pubescent beneath, and either quite entire, or divided into 2, or more commonly, 3 lobes; the berries are purple upon thickish red peduncles.

The Alligator-Pear (*Laurus Persea*), of the West Indies, affords a large eatable fruit, with something of the taste of marrow, or of a buyteraceous substance, and is greatly esteemed. From the distilled wood of the *Laurus camphora* is derived much of the camphor of commerce. The bark of the *Laurus cinnamomum* is cinnamon; and the unopened flowers with their footstalks of the *L. cassia* are the cloves, employed as a spice. No species of the genus extends so far to the north as the Spice-bush (*L. benzoin*), which may be met with in flower about April in shady and wet places, from Georgia to Canada uninterruptedly.

DECANDRIA.

As might be expected from corresponding symmetry, there is a considerable affinity between the 5th and the 10th classes, and also between this and the Papilionaceous plants of DIADELPHIA. Thus, for example, the *Baptisia* has exactly the corolla of the

Pea, but as the stamens are all separate, it finds place in the simple class DECANDRIA, instead of that of DIADELPHIA, which plants only differ from the present in the union of the filaments into 2 unequal bodies. It would, perhaps, have been better, at least where natural classification is at all concerned, to have merged the mere character of an union of filaments, and classed such plants rather by the number and disposition or insertion of their stamens, by which means, in this, and other cases, the artificial and natural methods might have been more happily and conveniently combined. Thus mere sections of the same natural order PAPILIONACEÆ would not need to be sought for in 2 remote classes.

In the *Baptisia*, or Wild Indigo, the calyx is bilabiate, with the border 4 or 5-cleft. The corolla papilionaceous, or irregular in its proportions, the petals nearly equal in length; the vexillum having its sides reflected; and the flower, according to the species, yellow, white, or rarely blue, and not much unlike that of the Lupin. The stamina are deciduous, in consequence of not being combined together. The legume ventricose and pedicellate, containing many smallish seeds. They are all perennial plants, chiefly of the southern and western states, with long tap roots, and low forked branches clothed with ternate leaves. The flowers are generally in terminal racemes. Our commonest species, growing in sandy woods, and flowering from July to September, is very much branched, with small, smooth, ternated, subsessile leaves, bearing terminal racemes, each containing a few yellow flowers, with the legume or pod pedicellated. This is called *Baptisia tinctoria*, in consequence of its having been once employed as a substitute for Indigo. The *B. cœrulea*, which grows occasionally on the sandy and gravelly shores of the

Potomac and Ohio, is a larger leaved plant, much less branched, and early producing its delicate blue flowers.

The *Cercis*, or Red-bud of the Indians, is another example of a papilionaceous plant with 10 uncombined stamina. It has its branches early in the spring loaded with clusters of fine red flowers, which make their appearance before the leaves, and is a small, spreading tree, at length, clothed with large, roundish, cordate leaves. The calyx is 5-toothed and gibbous, or swelled out at the base; the corolla papilionaceous, as already remarked, with the wings larger than the vexillum, and the keel (very unusual with this form of flower), consists of 2 separate petals. The legume is so much compressed, that but very few ever produce perfect seed, and the seminiferous suture is margined.

The *Cassia* (of which some of the species have been called Wild Pea), also one of the Leguminosæ, or Papilionaceæ, presents a very anomalous structure, having a 5-leaved calyx, and a spreading or open corolla of 5 nearly equal petals. The stamina are unequal in length, and the 3 upper ones have blackish, sterile anthers, the 3 lower have elongated or rostrate anthers, and are seated upon longer and incurved filaments. The legume is flat and membranaceous, but does not readily open. All these plants have pinnated leaves, which remain folded at night; and yellow clustered flowers. The *C. marilandica* is a common, tall, perennial plant in wet places and by the banks of rivers, bearing abundance of flowers about August, and the leaves have been employed as a substitute for the Senna of the shops.

Rhododendron, the type of a peculiar, natural order Rhododendraceæ, is certainly one of the most beautiful tribe of shrubs indigenous to America. To

this genus, as a mere Pentandrous section, is now referred the former genus *Azalea* of Linnæus, well known in many parts of the United States by the false name of Honeysuckle. These, as well as the Pontic Azalea of Asia, have all deciduous leaves; but the decandrous kind, or true *Rhododendrons*, have sempervirent leaves, and flowers more approaching to campanulate, with the border less deeply cleft. The character of the genus is to have a minute, 5-toothed calyx; a 5-cleft tubular, somewhat funnel-formed, and rather irregular corolla, of which the uppermost, central segment is always the largest, and frequently spotted or deeper colored. The stamina 5 or 10, are declinate; the anthers opening each by 2 terminal pores. The capsule 5-celled, 5-valved, opening at the summit.

Of *Azaleas*, or Pentandrous *Rhododendrons*, called Honeysuckles, the most common in dryish, shady woods throughout the middle states, is the ***R.*** *nudiflorum*, which so richly decorates and perfumes our woods in the month of May. In this species the flowers precede the full developement of the leaves, and present every shade of pink or rose-red nearly to absolute white, often with a tinge of yellow in the deeper colored centre of the larger upper segment of the corolla. In the southern states this species occasionally occurs of a perfect scarlet. This species is closely allied to the Asiatic or yellow Pontic Azalea, and the *R. calendulaceum* of the southern states and mountains, is apparently a mere variety of the Pontic kind.

The next common species, always in shady swamps, is the ***R. viscosum*** (formerly *Azalea viscosa*), or Swamp Honeysuckle, of which there are several spontaneous varieties needlessly erected into species. In this, the flowers are almost entirely white, extremely

fragrant, externally covered with a clammy or viscid pubescence, and never make their appearance until about June, when the leaves have attained their full growth. This species is almost the only one from Massachusetts to the north, and is not, I believe, uncommon in Canada.

Of the *Rhododendrons*, properly so called, our most common species, in mountainous, shady Fir, or Hemlock woods, is the ***R.*** *maximum*, called in many places Mountain Laurel. This is an evergreen, large leaved shrub, 10 to 15 feet high. In the mountains of North Carolina it is in such abundance as to form very extensive, and almost impenetrable thickets. From hence it prevails throughout the mountain tracts, at length descends towards the sea-coast, and finally disappears beyond the islands of Massachusetts bay. This species unfolds its splendid clusters of flowers about June or July. They are of various shades of pink, and sometimes nearly white, but without fragrance, as in all the other genuine Rhododendrons.

On the summit of the Catawba mountains, in North Carolina, is found a peculiar species of this genus (***R.*** *catawbiense*), growing much lower than the common kind, with broader and shorter leaves almost of a silvery whiteness beneath; the flowers are also large, and of a bright reddish purple, somewhat like those of the Pontic Rhododendron.

On the highest, swampy depressions of the White Mountains of New Hampshire, exists also the dwarf Lapland Rhododendron (***R.*** *lapponicum*), only a few inches high, characterised by its elliptical leaves, roughened beneath with excavated punctures, in which respect it somewhat approaches the ***R.*** *punctatum* of the mountains and hills of the southern states.

Nearly allied to Rhododendron, and of the same

natural family, is the elegant vernal flowering *Rhodora*, so common and ornamental to the bogs and swamps of the northern states and Canada. It has all the external character of an Azalea, and like the *nudiflora*, is clothed with its clustered purple flowers, previous to the developement of the leaves. But its corolla of 3 unequal petals, slightly united at the base, with the upper one thrice the breadth of the rest, and 3-lobed, at once distinguishes this peculiar American genus from all others in existence, and like the Rhododendrons, rather than the Azaleas, it is destitute of fragrance.

Of the same natural order as the 2 preceding genera, but very different in the form of the corolla, is the American genus *Kalmia*, of which the corolla is perfectly regular, and of the form of a deep edged salver, protruding beneath 10 prominent convexities in which the anthers lie for some time concealed, but when liberated, fly up towards the stigma. The capsule is short and round, with 5 cells, 5 valves, many small seeds, and the dissepiments formed by the inflected margins of the valves. All the species are shrubs, with evergreen, narcotic leaves, excepting the *K. cuneifolia*, which is deciduous. They have flowers in corymbs, and are either white or red. The most common species is the *K. latifolia*, Spoonwood or Calico-bush, which occasionally becomes almost a tree, and bears abundant clusters of white or rosaceous flowers, spotted at the base with deeper red. This species is found in shady and rocky woods, where the Hemlock tree abounds, flowers about June or July, and during its continuance in that state, is certainly one of the greatest ornaments which the American forests can boast.

The *K. angustifolia* of sandy woods and swamps is likewise very common, and much smaller than the

preceding, having the leaves by 3's, of a pale green, and the flowers small and always red.

The *K. glauca* is only met with in deep, mossy swamps, in mountainous situations; flowers rather earlier than the rest, and the corolla is large and elegant; but it is well known by its particolored leaves, very green above, and white or glaucous beneath, with the margin revolute, or turned down.

The *Vaccinium*, or Whortleberry, is a genus of shrubs of various sizes, with smallish, entire leaves, in some species evergreen. The calyx, which crowns the berry, is 4 or 5-toothed. The corolla urceolate, or campanulate, with the border 4 or 5-cleft. The berry 4 or 5-celled, many-seeded. The United States abound in species of this genus, and the fruit of several is wholesome and palatable. This genus is the type of a natural order VACCINEÆ, but scarcely differs from *Andromeda*, of the ERICEÆ, in any thing but the fruit, which in this last is a capsule of 5 cells and 5 valves, with the dissepiments from the middle of the valves.

In very shady woods, coming up from under the fallen leaves, you may perhaps, about August, chance to meet with clusters of a very curious plant of this class, called *Monotropa*, the type of a natural order MONOTROPEÆ. It is altogether white and diaphanous, or yellowish, at no time verdant; each stem, about a span or less, is clothed with scales, and terminated, according to the species or section of the genus, by 1, or several flowers in a raceme. These consist of a calyx of 3 to 5 parts, or is altogether wanting in some of the species. The corolla is campanulate, formed of 5 petals, cucullate, or concave at the base. The anther consists of 1 cell, and opens in a bilabiate manner. The capsule 5-celled, 5-valved. The seeds are numerous and minute, invested with a long arillus.

Somewhat allied to this genus is the *Pyrola*, or Winter-green, of which there are several species both in the United States and northern Europe. These grow commonly in clusters, in shady Fir woods, have running roots, and dark green, sempervirent leaves, generally roundish or oblong, from which arise low scapes, bearing 1, or many, sometimes fragrant, whitish flowers disposed in racemes. These consist, according to the genus, of a small 5-cleft calyx ; and 5 petals slightly united at the base. The stamina open with 2 pores, and the anthers become reversed. The capsule is 5-celled, and 5-valved ; and the seeds very small and numerous, are, as in the preceding genus, invested with a long arillus. The most common species is the *P. rotundifolia*, flowering about July or August. The leaves of a thick consistence, are rounded or dilated oval, obsoletely serrulate on the margin, with the petiole about as long as the lamina of the leaf ; the scape many flowered, and the style declinate or inclined downwards.

The *Chimaphila* or *Pipsisseway*, formerly referred to *Pyrola*, is a genus of evergreen plants with running roots, and oblong lanceolate leaves clustered at different distances along the stem, from the bosom of which arise pedunculated umbels of a few white or reddish flowers, constructed much like Pyrola, but with the filaments arising from as many round margined disks, and the germ destitute of any distinct style.

In the second order, or Digynia, you will find the genus *Dianthus* or Pink, being the type of the natural order Caryophylleæ. In this genus is included, besides the Pink of our gardens, the China Pink, Sweet William, and the small flowered Sand Pink (*D. armeria*). In this genus the calyx is 1-leaved, and tubular, with the border 5-toothed, its base commonly subtended by about 4 imbricate opposite scales.

The 5 petals are conspicuously unguiculate. The capsule cylindric, and 1-celled. From this genus that of *Saponaria* differs in having a similar calyx naked at the base.

The *Scleranthus annuus*, a common, small, inconspicuous annual in sandy wastes, belongs to the same natural family as the Pink, but has no corolla, and a campanulate, greenish calyx of 1 leaf, with 5 clefts. The stamina are inserted into the calyx ; and the capsule, containing only 1 seed, is covered by the calyx.

In the third order, or TRIGYNIA, of the tenth class you will find the genus *Silene*, belonging to the same natural order with the Pink, and bearing a similar flower, but distinguishable, at once, by its naked, 1-leaved, tubular or conic calyx, 5-toothed at the summit, having a capsule of 3 cells, containing many seeds, and opening at the summit by 6 teeth. The clawed petals are also mostly crowned at the base of the border with a small cleft process. One of the prettiest vernal flowering species is the *S. pennsylvanica*, and so far from being peculiar to that state which gives its specific name, it is not uncommon from Florida to Canada. It forms a low tuft, sending up from its cluster of wedge-shaped root leaves, many low stems, terminating in trichotomous or 3-forked panicles of pale red or pink flowers, having the petals a little emarginated or notched, and somewhat crenated along the whole margin. The *S. virginica*, which grows in rocky and shady woods as far north as the western parts of Pennsylvania, has weak, forked branches ; and panicles with bifid petals, and exserted stamens ; this species has deep scarlet flowers of great beauty. The *Cucubalus* is a mere section of this genus, distinguished by its roundish and inflated calyx. The most common species is the *S. bchen* or Campion ; it is smooth and glaucous, with decumbent or trailing stems ; acute,

nerveless, oblong leaves, with a reticulately veined calyx, and very evanescent white flower. But the most remarkable species is the *C. stellatus*, deriving its specific name from the peculiar character of its leaves, being verticillated or stellated, and growing in 4's; they are also minutely, but closely pubescent, and of an oval lanceolate form, with a long acuminated point. The petals are white, divided almost like fringe, and, like the preceding, the flowers are chiefly open in the evening.

In Decandria Pentagynia, still among the natural family of the Pinks, you will find the *Cerastium*, or Mouse-ear Chickweed, a set of very common, small, low growing, hairy leaved plants, with small white flowers, like Chickweed. These will be found to consist of a calyx of 5 leaves; 5 bifid, cleft, or emarginate petals; and, at length, a cylindric-ovate, curved capsule, of a thin texture, with 1 cell, containing many seeds, and bursting at the summit only into a margin of 10 teeth.

In the *Agrostemma*, or Cockle, a common annual weed amongst corn, at least, the *A. githago*, which is a hairy, narrow-leaved plant with Pink-like conspicuous purple flowers, there is a 1-leaved, tubular, thickish calyx, with 5 long clefts or segments; 5 unguiculate petals, with an obtuse undivided limb or border; and a capsule of 1 cell, opening by 5 teeth.

In the order Decagynia, or 10 styles, you will find the Common Poke (*Phytolacca*) of the natural family of the Atriplices. The generic character is, a 5-cleft petaloid or colored calyx; and a superior berry of 10 cells, with 10 seeds. You will readily find this large herbaceous plant by way-sides, near fences, and in wastes, generally where the soil is good. It continues flowering from June to October; the flowers are in racemes, coming out opposite the lanceolate leaves,

and continue to be succeeded by a profusion of blackish berries, filled with an abundant purple juice. Like most of the plants of the same natural order, the young shoots of the Poke are boiled and eaten as greens, though the older plant is said to be deleterious, and the berries are considered medicinal.

CHAPTER XIX.

OF THE CLASS ICOSANDRIA.

We now come to the consideration of a class in which the number of stamens, often considerable, is so inconstant, that their mere notation is of less consequence than the part of the flower on which they are inserted. Three of these classes were given by Linnæus, namely, Dodecandria, Icosandria, and Polyandria. The name of Dodecandria might lead us to a belief that it was intended exclusively to classify such plants as had 12 stamens, but in place of any such certainty, it is said to be intended to contain all plants with 12 to 19 stamens inclusively, without any regard to their point of insertion. It is obvious, however, to all who have ever attentively examined these Dodecandrous plants, that these numbers are illusory, and that all the plants so referred, ought to find place either in Icosandria or Polyandria, otherwise species of the same genus might be referred to 2 classes; as in Agrimony, where, according to the species, there are flowers with 7, 10, and 12 to 20 stamens, or Dodecandrous and Icosandrous species. But here, as is the general case, in this and the following classes, the inconstancy of the number and the point of insertion are the only valid characters of the class; the stamens out of all certain symmetry with the parts of the flower, varying,

according to the genera and species, from even 7, or 9, to a thousand. Our present class then includes a part of that of the former indefinite *Dodecandria*, or all plants with an irregular, or *uncertain* number of stamens, from 9 to 1000; but often about 20, as the name *Icosandria* would imply, inserted upon the sides of the calyx.

In the first order, or MONOGYNIA, of this class, you will find *Cactus*, a genus chiefly peculiar to South America, forming almost the exclusive type of a natural order of the same name, CACTI. These are succulent or fleshy plants, mostly destitute of leaves, and many, in their native warm climates, attain to considerable trees. They are generally beset with clusters of radiating spines; have angular, jointed, erect, or prostrate stems; and very considerable, and often magnificent flowers, some of which open exclusively in the evening. They divide themselves, however, into several natural sections, if not genera, and so elude any general description. Our only northern and common species in sandy fields and wastes, is the *C. opuntia*, the type of a section *Opuntia*, or Indian Fig, in which the whole plant consists of roundish, flat, or Fig-shaped joints proliferously protruded from each other, at an early stage covered with small cylindric scattered leaves, and, at length, clothed with spines and insidious bristles. From these joints are also protruded large, pale yellow flowers, formed of numerous petals, arranged in several series. The calyx seldom, and never essentially, distinct from the petals, consists of many imbricated segments. The stigma is many cleft. The berry inferior, 1-celled, and many seeded, filled with a very slow ripening glutinous pulp. The flowers of this species open only to the sun, and the numerous stamens, when touched, show a very evident sensibility, approach the stigma, and at length nearly close the corolla.

The most splendid species of this genus is the Night-blooming Cereus (*C. grandiflorus*), bearing flowers near a foot in diameter, with the calyx yellow, and the petals white. They have the odor of vanilla; begin to open soon after sunset, and close next morning to open no more; the stem is round, pentangular, and weak or trailing, as is, also, that of the more common, and easier cultivated Creeping Cereus (*C. flagelliformis*), which has about 10 angles, and is closely beset with spiny bristles; the flower is very conspicuous, a fine red, and continues a long time in blossom both day and night.

Prunus, the genus of the Plum and Cherry, belongs to the natural order of the Rosaceæ, and has an inferior, campanulate, 5-cleft, deciduous calyx; 5 petals; a smooth drupe; and a nut with a prominent suture.

In *Lythrum*, which forms the type of the natural order Salicariæ, the calyx is tubular, and sometimes partly campanulate, with a 6 or 12-toothed border. The stamina, contrary to almost all the plants of this class, are constant in number in each species, being in some 6, in others 12, but as well as the 6 equal petals, inserted upon the sides of the calyx. The capsule is 2 to 4-celled, and many-seeded. Our most common species is the *L. verticillatum*, which has a 10-toothed, almost companulate calyx, and a capsule of 3 or 4 cells. It grows on the edges of ponds, and in swamps, sending out from a woody perennial root, many curved pubescent branches, which not unfrequently take root again at their extremities on approaching the ground. The leaves are lanceolate, opposite, or by 3's; the flowers are red, axillary, verticillate, and decandrous, with undulated petals. The capsule is nearly globose. This species approaches somewhat to the splendid Indian and Chinese genus *Lagerstrœmia*, belonging

likewise to the same natural family, but extremely remarkable for its distinctly-clawed, dilated, and very undulated or ruffle-like fine petals.

Nearly allied to *Lythrum* is *Cuphea*, differing by its ventricose calyx ; which, at length, with the 1-celled capsule, bursts longitudinally, and exposes upon a toothed receptacle, the large lenticular seeds. The petals, 6 in number, are also unequal, and attached or inserted on the calyx. The only species in the United States is *C. viscosissima*, being viscid ; having opposite, petiolate, ovate, oblong leaves ; lateral, solitary flowers on short peduncles, furnished with 12 stamens. In certain places, and by way sides, it is rather a common plant from Pennsylvania southward, and bears its purple flowers about September, after which it perishes, being only annual.

The next order is very properly termed Di-Pentagynia, there being, as in *Cratægus*, species in the same genus with 1 or 2, to 5 styles. The *Cratægus*, or Hawthorn, which needs no description but that of the genus, has a superior, 5-cleft calyx ; 5 petals ; and a closed pulpy fruit, resembling a berry, with from 2 to 5, 1-seeded nuts. This genus belongs also to the Rosaceæ, and is allied to the *Sorbus*, or Mountain Ash, which has also a 5-cleft calyx ; 5 petals ; 2 or 3 styles, and an inferior or crowned berry, with a farinaceous pulp, including 3 cartilaginous seeds, like the pippins of the Apple. These are small trees growing in mountain bogs, having pinnated leaves like Ash, and clustered scarlet berries, which add greatly to the autumnal ornament of the forest and pleasure ground.

The *Agrimonia* (Agrimony) is another genus of the Rosaceæ. They are herbs with some fragrance, having simple or undivided herbaceous stems, clothed with hairy interruptedly pinnated leaves ; and terminating in slender spikes of small golden yellow flowers of 5 pe-

tals, with an inferior, 5-cleft, hispid or bristly calyx; 7 to 20 stamens; and only 2 hard coated seeds in the bottom of the calyx.

In *Pyrus*, the genus of the Apple and Pear, of the section Pomaceæ, in the Rosaceous order, the calyx is 5 cleft; the petals 5; the Apple inferior, or crowned by the calyx, large, and of a fleshy or solid consistence, including a 5-celled, few seeded capsule; the seeds themselves furnished with a cartilaginous coating. The *P. coronaria*, or Native Crab, is remarkable for the beauty of its somewhat fragrant blossoms, and the leaves, instead of being entire, have often an evident tendency to lobing. The Apple or Crab of this species, when ripe, is almost diaphanous, entirely yellow, and on mellowing becomes very fragrant; it has also scarcely any depression at the insertion of the stalk.

The genus *Aronia*, or Shad-blossom, as it is called in New-England, is the same with the *Amelanchior* of Europe, and scarcely different from *Pyrus*, having the same kind of seed, inclosed, however, in a berry, rather than an apple, with 5 to 10 cells, the cells 1 to 2-seeded. These form one of the prominent ornaments of our forests, about the month of May, when the branches appear as if loaded with clusters of white fringe, from the narrowness of the petals. They come out likewise before the full developement of the leaves, and are disposed in racemes or corymbs.

In Polygynia, of the Icosandrous class, you will find the Rose (*Rosa*), so long and deservedly celebrated for its beauty, variety, and fragrance. The calyx, in the form of a pitcher, or urceolate, contracted at its orifice, and terminating above in a deciduous 5-cleft border, is the peculiar and most distinguishing trait of the genus. The 5 petals are remarkable for their great size and fine color. The seeds, very nu-

merous, and hispid, are attached all round the interior base of the calyx. With some of the principal traits of the other Polygynous genera you are already partially acquainted in a former chapter. To these we may add the character of the *Calicanthus*, Sweet-Shrub, or Carolina Allspice bush, whose flower, in many respects, resembles that of the *Cactus*, being composed of a superior, somewhat urceolate, many parted calyx, the segments squarrose, in several series, colored and petaloid; no corolla; many styles; the seeds numerous and naked, included in a venticose, succulent calyx. This genus, in fact, forms the type of a natural order apart, but deserves to be compared with the CACTI. All the species of this North American genus are shrubs with camphorated roots; opposite broad leaves, scabrous on the upper surface; with terminal, and lateral, sessile, brown flowers, giving out, towards evening, principally, a delightful odor like that of strawberries or ripe apples.

CHAPTER XX.

OF THE CLASS POLYANDRIA.

The class POLYANDRIA, like the preceding, has an indefinite number of stamens, namely, from 15 or under, to 1000; but instead of growing out from the sides of the calyx, they originate on the common receptacle beneath the germ, as you will readily perceive by examining the flower of a Poppy, which has a caducous or quickly falling calyx of 2 leaves; a corolla (when not double) of 4 petals; and a roundish, large capsule without any valves, but, internally, divided into as many cells as there are rays in the many-toothed, discoid stigma. The sides of the capsule, on drying,

shrink from the horny persisting stigma, and leave openings at the summit of every cell by which the seeds escape on the slightest agitation. These seeds are exceedingly numerous, and filled with a mild and pleasant flavored oil employed in the arts, being obtained by expression, and might safely be used for diet, which is not the case with the herb itself, for the milky juice so abundant in the capsules, when inspissated, by simple drying on the plant from which it exudes on incision, is the narcotic, but very important, and useful lethean drug, Opium. Although several species afford this milky sap, the *Papaver somniferum* is chiefly cultivated for this purpose, and produces spheroidal capsules as large as oranges, preceded by white flowers, and having white seeds. The Poppy is the type of a natural family PAPAVERACEÆ, to which also belongs the

Celandine, or *Chelidonium*, a common plant about old garden walls, and under shady hedges, in flower the greatest part of the year; its milky sap, as well as small flowers, are yellow, constructed exactly as in the Poppy; but the stigma is small, sessile, and bifid; succeeded by a long, narrow silique or pod-formed capsule of 1 cell, with 2 valves, and many crested seeds, attached to 2 thread-like receptacles.

The *Meconopsis* (*Chelidonium diphyllum* of Michaux), not uncommon in the western states, in moist and rich shady woods, particularly along the banks of the Ohio, differs only from the Celandine, which it resembles, in flower and leaf, by having a distinct style; a 4 to 6-rayed stigma; and an oblong, bristly, 1-celled capsule, opening by 4 to 6 valves, containing many seeds attached to filiform receptacles.

The *Sanguinaria*, or Bloodroot, likewise belonging to the PAPAVERACEÆ, is one of our earliest vernal ornaments, sending up its lively, white, and large flowers

from the bosom of the withered leaves of the forest, by which they are commonly protected from the cutting winds of the season. The roots, growing in clusters, are abrupt, and thickish tubers full of a bitter, milky sap of a brownish, bright red color, appearing almost like blood. From these issue low stems, each consisting of a single lobed leaf, at first folded over the stalk and its only flower, which is protected by a 2-leaved, deciduous calyx. The corolla consists of about 8 expanded petals; 2 stigmas; the capsule oblong, and pointed, 2-valved, 1-celled, with many seeds attached to 2 filiform receptacles. Allied to this genus, but forming the type of a distinct natural order, is the

Podophyllum, or May-Apple, falsely called Mandrake, of which genus, like the preceding, there is but a single species known, and both of the plants are peculiar to North America. This plant is also one of the characteristic, and rather common vernal ornaments of our forests. The roots run profusely, are esteemed in medicine as a valuable cathartic, and send up, at near intervals, stems with 2 leaves of an orbicular form, and lobed on the margin, with that peculiar and uncommon mode of attachment in the petiole, under the centre of the disk, which constitutes the peltate leaf, and hence its specific name of *peltatum*. From the centre of these 2 leaves issues a single pedunculated, nodding, white, and rather large concave flower, having a 3-leaved calyx; about 9 petals; a large crenate, or rather crested stigma; a thick skinned, 1-celled, ovate, large berry, containing many seeds immersed in a one-sided, large, and diaphanously pulpy receptacle; which pulp, at first fœtid, when ripe, becomes, with the whole opaque berry, fragrant, of a very pleasant sweetish acid taste, and as the May-Apple, is commonly eaten, and considered wholesome.

The most curious plant of this class is undoubtedly the peculiar North American genus *Sarracenia*, termed in England the Side-saddle flower, or rather leaf, as the resemblance only exists there, to the old-fashioned side-saddle. It has no distinct affinity with any other genus yet discovered, though somewhat allied to *Nuphar*, the yellow Pond-lily, and will form, no doubt, the type of a distinct natural order, as well as genus. The *S. purpurea*, or most common species, is found only in wet, mossy bogs, and is an evergreen perennial, sending up for leaves, clusters of peculiar processes, which have been termed *ascidia*, from the Greek *ἀσκὸς, a bottle.* They are hollow, tubular appendages, enlarging above, where they remain open, or but slightly sheltered by a broad valve-like process, undulated, or arched over this extremity of the tube; above, and lengthwise, this tube sends off a leafy ridge. In the yellow flowered species, so common in Virginia and the southern states, these *ascidia* are very long, and not unaptly resemble trumpets, the name by which the plant is there generally known. From the bosom of these curious leaves, commonly filled with water and dead insects, arise, in June, a number of scapes producing yellow or red flowers, consisting of a double persisting calyx, the external one smaller, and 3-leaved; the inner 5 leaved. The petals 5 deciduous, spreading out from beneath the very large, persistent, peltate stigma, which overshadows the numerous stamens. The anther is adnate to its filament. The capsule is roundish and scabrous, 5-celled, and 5-valved, many seeded. The seeds are also somewhat scabrous and compressed.

The Purslain (*Portulacca*), the type of the order Portulaceæ, belongs also, as well as all the preceding genera, to the first order of our class. This succulent annual weed, with wedge-shaped leaves, is but

too common in sandy soils, and in the latter part of summer seems to grow up like a Hydra. Its flowers, small and yellow, are seldom open, and with the stamens, sensitive like those of the Cactus, frequently close at the touch. The calyx is inferior, and bifid; the petals 5; the capsule 1-celled, opening across into 2 cups or hemispheres. The numerous seeds are attached to an unconnected 5-lobed receptacle.

The *Nymphæa*, or Pond-lily, the type of the NYMPHÆACEÆ, is one of our most beautiful aquatics, sending up numerous floating, roundish, heart-shaped leaves; and scapes, each terminated by large showy flowers; having a 4 or 5-leaved calyx, and many rows of large petals inserted upon the germ. The filaments appear as so many narrower and inner petals adnate to the anthers, the cells of which are thus, often, widely separated. The stigma is discoid, radiated like that of the Poppy, and the unopening capsule or succulent pericarp contains as many cells as there are rays in the stigma; the seeds are numerous.

In the order DI-PENTAGYNIA, or that of flowers with from 2 to 5 pistils, will be found *Delphinium*, or the genus of the Larkspur, of the natural order RANUNCULACEÆ. There appears to be no calyx; a corolla of 5 petals, and an inner set, or lepanthium of 2 recurved, and pedunculated petal-like processes in the Aconite or Monkshood; but of only one sessile, but bifid petal, continued backwards into a spur in the Larkspur. The common garden species has but one capsule; but some of the native species, not very common plants, have as many as 3.

In the Columbine (*Aquilegia*), belonging to the same natural family with *Delphinium*, there is a 5-leaved, petaloid calyx; and 5 very singular, hollow, tubular petals, or rather lepanthia, terminating below in spurs or horns containing honey. The capsules

are 5, many-seeded, and acuminated with the persisting styles. Our common, coral-colored flowering species (*A. canadensis*), like most of the genus, has biternated, or twice 3-parted leaves, incisely or deeply toothed at the extremity. The scarlet flowers hang pendulous, with the styles and stamens exserted, and form, in rocky situations, one of the most elegant vernal ornaments of the season.

The Peony (*Pæonia*) is also another genus of the Ranunculaceæ, and one of the most gaudy ornaments of the flower-garden. It bears a 5-leaved calyx; (when single), a corolla of 5 petals; and 2 or 3 germs, crowned by as many stigmas; the capsules the same number, each contain several seeds. These have also ternately divided, and compound leaves, and, in the *P. tenuifolia*, nearly as finely dissected as those of Larkspur.

In the order Polygynia, you will find the beautiful Tulip-tree, or *Liriodendron*, sometimes, improperly enough, called Yellow Poplar, from the color of its wood. The form of its leaves truncated, or as if cut off squarely at the extremity, and so giving it something of the form of the ancient Lyre, is very peculiar. It belongs to the same natural family with the *Magnolia* (Magnoliaceæ), and is distinguished from it principally by the fruit, which consists of a dry cone of imbricated, and partly lanceolate pericarps, each containing 1 or 2 seeds. The calyx, as in *Magnolia*, is 3-leaved, and the petals 6.

In *Magnolia* the petals are 6 to 9; and the fruit an imbricated cone of 2-valved, 1-seeded capsules; but the seeds are covered with an aromatic red pulp, and, when ripe, they hang out of the capsules by a funiculus, resembling a white and silken thread. All the species of this genus are remarkable for their beauty and fragrance; indeed, the flowers of the

M. macrophylla of Lincoln, in North Carolina, are said to be 14 inches in diameter; and the leaves, disposed in clusters at the ends of the branches, white beneath, and pale green above, attain sometimes a length of 3 feet. The whole genus are trees or shrubs peculiar to North America and China. Of the Tulip tree there are 2 other species in India. The most splendid tree in America is certainly the *Magnolia grandiflora*, which extends from Charleston, in South Carolina, to the shores of the Gulf of Mexico. Near Savannah, in Georgia, I have observed trees with a smooth shaft of about 90 feet before sending off any considerable branches; the spreading top is clothed with deep green, oblong-oval leaves, like a Laurel; these are, at most seasons, enlivened either by large and fragrant flowers, or cones, decorated, as it were, with pendulous scarlet seeds. Our most common species, in every dark, swampy forest near the sea-coast, is the *M. glauca*, or Swamp Sassafras, which extends from the sea islands of Massachusetts bay to East Florida. This species forms a low tree or shrub, with brittle, white, smooth branches, and oblong, laurel-like, but deciduous leaves, whitened or glaucous beneath; from the bosom of these arise numerous cream-colored, extremely fragrant, cup-shaped flowers, which continue longer in succession than in any other species. The *M. acuminata*, a large tree of the western states, and the back parts of Pennsylvania, bears inconspicuous, yellowish green flowers; and the *M. tripetala* of Virginia, or Umbrella tree, is remarkable for the length of its leaves, tufted, so as to spread out at the extremities of the branches like an umbrella; this bears also large, showy, white flowers, very strongly and pleasantly fragrant at a certain distance. The *M. cordata*, little more than a variety of *M. acuminata*, is remarkable for its abundance of fine, yellow flowers.

The *Anemone*, of the Ranunculaceæ, is a genus of which you will find some of the species very early in flower in the shade of the forest, particularly the *A. nemorosa*, growing in spreading clusters, and thickly scattered, with the stem low, bearing 3 leaves, all connected together at the base; the segments are 5-parted, deeply toothed, lanceolate, and acute. Above these comes out a similar involucrum; and only a single white, or externally reddish or purplish, bell-shaped flower of 6 parts, resembling petals, but being rather a calyx. The character of the genus is, to have a 3-leaved involucrum distant from the flower, with its leaflets divided. The calyx is petaloid, with from 5 to as many as 15 leaves. There are no proper petals in this view. The seeds are numerous, and either, as in the *Pulsatillas*, ending in long plumose awns, or naked of this appendage; and in some species, as in *A. virginica* and others, producing a copious quantity of wool at their base. These ought properly to be separated, at least, from the *Pulsatillas*, which have the plumose seeds of Clematis.

Hepatica has been removed from Anemone, from which it differs, no doubt, in general aspect. This has a 3-leaved, undivided involucrum, near the flower, and so resembling a calyx. The petaloid calyx (commonly blue, sometimes white, or red) has 6 or 9 leaves, or even more in *H. acuta*, disposed in more than one series, and the seeds are without awns or down. These are very early flowering, evergreen plants, with 3-lobed leaves, hence called Liverwort. The flowers grow in considerable clusters, particularly when cultivated, and then often occur double.

The *Ranunculus* (Crowfoot or Buttercup), giving name to a natural order, of which we have already quoted several genera, has flowers (commonly yellow)

furnished with a 5-leaved calyx ; and 5 petals with a nectariferous pore, and small scale at their base, on the inside. The capsules or carpels are numerous, ovate, and mucronated with the remaining stigma, containing 1 seed, but, like a nut, not opening. The species of this genus are numerous, and many of them common in every field and lane. They have generally deeply and much divided leaves ; and the yellow, cup-shaped flowers appear internally as if varnished. The Persian Ranunculus, *R. asiaticus*, with its numerous and various colored double flowering varieties, is one of the greatest ornaments of the garden, presenting brilliant colored flowers, nearly as large as roses, and coming out at an early season of the year. The roots of these in a dry state, consisting of little tufts of cylindric tubers, are commonly imported from Holland, the great mart of the florist.

The largest flowered plant in America is the *Nelumbium*, belonging to the NYMPHÆACEÆ ; an aquatic of the southern and western states, growing also near Philadelphia, readily known even by its large leaves, which are perfectly orbicular and peltate, and either float or rise out of the water. The peduncles always appear above the surface, each bearing a large, yellowish white flower, having a petaloid, 4 to 6-leaved calyx ; and many concave petals. The pericarps or nuts, like acorns, each containing 1 seed, are entirely immersed to the summit in a top-shaped, or turbinate spongy receptacle. Of this genus there are also 1 or 2 other species in India and China ; that of India scarcely differing from the *N. luteum* of this country in any thing but the fine rose color of its flowers, and more scabrous peduncles.

CHAPTER XXI.

THE CLASS DIDYNAMIA.

This class and its 2 orders each embrace a very natural and similar assemblage of plants. The general character of the flower, as we have elsewhere already remarked, is its irregularity, being almost universally ringent, gaping, or personate with the lips closed. The corolla in all is monopetalous; and the stamina 4, in 2 pairs of unequal length, so situated in consequence of the inequality of the corolla. This distinction in the length or proportion of the stamens, consequent on the peculiar trait of the corolla, is the foundation of this class, and hence called Didynamia, or 2 powers; but, as in 2 very distinct natural orders of the same class so characterized, there exists but one pistillum, it became necessary to have recourse to some other character for the foundation of the orders, such a distinction is then very obvious in the fruit; for in the first order, including all the 4 stamened Labiatæ of the natural method of arrangement, in which, as in the following order, there is but one style, there is always in the bottom of the calyx 4 apparently naked seeds, and hence the ordinal name of Gymnospermia. But in the 2d order of irregular flowers with didynamous stamens, the single style is succeeded by a regular, and commonly 2-celled capsule, containing abundance of small seeds attached to a central receptacle.

The 2 orders of this class, in a natural point of view, are quite distinct from each other; and, notwithstanding the nominal similarity of the fruit in the Asperifoliæ of Pentandria, which have also 4 carpels in the bottom of the calyx, no 2 families of

plants are much more dissimilar in aspect or general character than these when compared with the LABIATÆ. That they are allied to plants of the 5th class, however vaguely, is still certain from the quinary divisions of the calyx and corolla. With regard to the 2d order of this class, ANGIOSPERMIA, their affinities with plants of the 5th class is unquestionable, several bearing, even with the irregular corolla, still the plain rudiments of the 5th stamen, as in Foxglove, *Pentstemon*, *Bignonia*, *Antirrhinum*, and others. The *Peloria*, a variety of *Antirrhinum Linaria*, or Toad-flax, is perhaps one of the most remarkable things in the vegetable kingdom. This species, like the rest, ordinarily bears a personate or close-lipped corolla, from the lower segment sending out a long spur. Internally is found 4 didynamous stamens, and the slight rudiment of a 5th. But, in the *Peloria*, this irregular flower is transformed into a regular one, with an equal, 5-lobed, reflected, convex border, ending below in 5 equidistant spurs; and within containing 5 equal and perfect stamens. There is nothing here of that monstrosity which characterizes double flowers; there are only 5 lobes to the border as in ordinary, and only 5 stamens, but perfected, instead of 4 of unequal length, and the rudiment of a fifth. The conclusion is, therefore, obvious, that this apparent monstrosity, or departure from the ordinary course of abortion and imperfection of parts, is, in reality, the genuine symmetry, not merely of *Antirrhinum*, but probably of all the genera of the 2d order of Didynamia; and, that the ordinary irregular figure of the flowers of this class, and their abortion of parts, is the real monstrosity, of which the rarely produced regular flowers, as in Peloria, are the symmetrical type; and we see here another example of the great

prevalence of the quinary division or addition of parts in the flowers throughout the *Dicotyledonous* class of plants.

THE ORDER GYMNOSPERMIA

is, in fact, the remaining LABIATÆ of the natural method, not included in the 2d artificial class of Linnæus. In all these plants a common resemblance is obvious; they are many of them aromatic, all of them square-stemmed, and opposite-leaved; generally producing their flowers in whorls or axillary clusters at the summit of the stem, brought often so near together as to resemble a spike. They may be conveniently divided into 2 sections: in the first of which divisions of genera

The calyx is mostly 5-cleft, and nearly regular.

The first of these genera, which commonly offers itself in our Floras, and in nature by the banks of streams and in low grounds, in flower about midsummer, is the *Teucrium*, which you cannot mistake, as it entirely wants the upper lip of the corolla, or rather, it appears cleft, and the stamens will be found protruded through the conspicuous fissure. We have but 2 species which are common, both with ovate, entire leaves; in one inclining to lanceolate (*T. canadense*); in the other to oblong, and above sessile (*T. virginicum*). The flowers are brought together so closely, as to form a spike. These species are very nearly related, and, contrary to most of the European ones, have little or no odor.

The *Isanthus*, a peculiar American annual, deviates very remarkably, as its name implies, from most other LABIATÆ, by the regularity of its 5-lobed (blue)

corolla, almost like a funnel, with a straight and narrow tube. The calyx is campanulate (externally bluish); the stamens, as might be expected, nearly equal; and the stigma linear and recurved. This plant is not uncommon, by way sides, in the middle and western states, and is covered with a somewhat viscid pubescence of a strong and rather heavy, but not unpleasant, odor.

The Catmint (*Nepeta*) has a dryish striated calyx; the tube of the corolla rather long, the intermediate segment of the lower lip crenate, with the margin of the orifice reflected. The stamina approach each other. The strong peculiar odor of most of the species of this genus is well known, particularly that of the common kind (*N. cataria*), which renders it very attractive to cats, and they often tear and devour it with greediness.

The Groundivy, or *Glechoma*, a trailing, prostrate plant, with roundish, strong smelling leaves, and pretty small, blue flowers, may be known, at once, from other genera, by the disposition of its white anthers, which approach each other in pairs, so as to form a cross. It has also the upper lip of the corolla bifid.

Horehound, or *Marrubium*, may easily be recognised by its 10-ribbed, 10-toothed calyx; it has, besides, the upper lip of the corolla narrow, straight, and cleft. The common species by way sides, near houses, has hoary, wrinkled, roundish-ovate, toothed leaves.

The *Pycnanthemum*, or Mountain-mint, an American genus, may be known by having its small, pale colored flowers disposed in heads, and surrounded by an involucrum of many narrow bractes. The calyx is tubular and striated; the upper lip of the corolla nearly entire; the lower lip 3-cleft. The stamina nearly equal and distant. In the 2d section the

Calyx is bilabiate.

Here you will find the Marjoram *(Origanum)*, which has the flowers collected into a dense 4-sided spike, and the upper lip of the corolla straight, flat, and emarginate. The common species *(O. vulgare)* will be met with in dryish fields, somewhat elevated, in flower from June to October, or even November.

Dracocephalum, or Dragon's-head, of which the United States afford several fine perennial species, may be known, at once, by the remarkable inflation of the orifice of the corolla; the upper lip is concave, and the stamina unconnected. The *D. virginicum* is rather a tall plant, (at least when cultivated,) and remarkable for its very regularly arranged, crowded, and elongated spikes of conspicuous pink flowers. Its leaves are also narrow, lanceolate, and serrate.

Prunella, or Selfheal, common every where, but particularly by way-sides, is readily distinguished by its dense spikes of bright blue flowers; and by the calyx, of which the upper lid is flat and dilated; but more particularly recognisable by its forked filaments (not articulated as in Sage), one of the points only being antheriferous.

Scutellaria, or Skullcap, is at once known from all the other Labiatæ by the peculiarity of its calyx; the upper lip covering the fruit like an operculum or lid, and with its edges entire. There are a considerable number of species in the United States, all of them bearing blue flowers, curved upwards, and having a wide orifice to the corolla. The *S. galericulata*, with cordate lanceolate, subsessile, crenated leaves, and axillary, solitary flowers, has been somewhat celebrated as a specific for hydrophobia; but it is, in all probability, very little entitled to such merit.

The *Trichostema*, or Blue-curls, is a genus peculiar

to the United States, being annuals, of which there are only 2, very nearly allied species. The common *T. dichotoma*, in flower from about July to September, is frequent on gravelly and sandy hills, being low and much branched, with an aromatic and rather heavy odor. The flowers are of a bright blue, and remarkable for the narrow, falcate or curved appearance of the upper lip of the corolla. The calyx is also resupinate, or lying along, as it were, upon its back. The stamina are very long, and incurved.

THE ORDER ANGIOSPERMIA.

The plants of this order have very little relation with those of the preceding; and are easily distinguished by having a proper capsule. The corolla, in many of the genera, is personate or closed, in others open, and approaching to the regularity of the simple pentandrous class. There are here also 2 sections, characterized by the calyx, which is 4 or 5-cleft. The first we shall notice have the

* *Calyx 5-cleft.*

The Vervain (*Verbena*) appears distinctly related to the preceding order, as it has 2 to 4 seeds, or carpells, inclosed, at first, in a thin evanescent pericarp, but when mature, they appear naked. The calyx has one of its teeth or dentures truncated; and the corolla is funnel-formed, with a flat, slightly unequal 5-cleft border. The stamens 2 to 4. Several of the species are rather common weeds in moist grounds, and by way-sides, particularly the Nettle-leaved Vervain (*V. urticifolia*), with rough leaves, like Nettles in form, and bearing filiform, or very slender spikes of inconspicuous white flowers. The *V. hastata* is a tall

plant with thicker, long spikes of blue flowers; and with the lanceolate, deeply serrated leaves occasionally lobed, or halbert-shaped at the base, particularly the lower and larger ones. This genus is the type of a natural order VERBENACEÆ.

Scrophularia, or Figwort, is remarkable for its brown, and almost globular flowers, which are resupinate, divided into 2 short lips, with an intermediate scale. The capsule is 2-celled. The common species, *S. marilandica*, has nettle like fœtid leaves. This genus is the type of the natural order SCROPHULARIÆ.

The *Bignonia*, or Trumpet-flower, is also the type of an order of the same name, and one of the most beautiful and showy genera of this artificial order. The calyx is cup-shaped, of a leathery consistence, with a 5-toothed border. The corolla campanulate, 5-lobed, and ventricose or swelled out on the under side. The capsule is a kind of 2-celled silique; and the seeds membranaceously winged. Our common species, occasionally found by the banks of rivers amidst bushes, and in flower from July to August, is the *B. radicans*, having a creeping, long branched stem, which sustains itself to neighboring objects and rocks by the adhering fibres which the branches send out, like Ivy, at short intervals. The leaves are pinnated; and the flowers, large and scarlet, are sparingly produced in terminal clusters from branches of the present year. These flowers commonly contain the rudiments of a 5th stamen.

Antirrhinum, or Toad-flax, is another genus of the SCROPHULARIÆ, which presents, in ordinary, a 5-parted calyx; a personate or ringent corolla, with a prominent nectariferous spur at the base. The capsule is 2-celled, bursting at the summit, with reflected teeth. The most common species of the genus is *A. Linaria*, a perennial with running roots, growing profusely in

wastes and by road sides; in flower from June to November. The stem is simple and terminated by a dense spike of rather large flowers, sometimes called Butter and Eggs, from the fine contrast of yellow and orange which they present. The leaves are linear and crowded. Of the *Peloria*, one of its extraordinary varieties, we have already spoken.

The curious *Collinsia*, of the shady banks of the Ohio, and the western forests of Pennsylvania, belongs also to the same natural order with the preceding genus. It has a 5-cleft calyx; a bilabiate corolla, with the orifice closed; the upper lip bifid, the lower trifid, the intermediate segment forming a keeled sack, in which are included the declinate style and stamens. The capsule is globose, partly 1-celled, and imperfectly 4-valved; seeds few, umbilicate. The *C. verna* is a low annual, flowering in May; with opposite, ovate, oblong, sessile, obtuse leaves, the lower ones petiolated; and having a capsule containing only 2 or 3 seeds. The flower is beautifully particolored, the upper lip being white, the lower a fine blue. A second, and very similar annual species is found on the banks of the Arkansa, west of the Mississippi; which I propose to call *Collinsia* **violacea* from the peculiar hue of the corolla. In this species the capsule contains 8 to 12 seeds.

Another very ornamental American genus of this order is *Gerardia*, of which there are no inconsiderable number of species in the United States, and several of them rather common. The genus is divisible into 2 sections from the color of the corolla; as, those with purple, and those with yellow flowers. In the form of the corolla and general aspect they appear as the counterpart of the European Foxglove, and might well be called the American Foxglove. They have a calyx which is half way down 5-cleft, or 5-toothed. The corolla is somewhat campanulate, unequally

and obtusely 5-lobed. The capsule 2-celled, opening above. The *G. purpurea*, flowering from August to October, is not unfrequent in moist sandy soils, and marshes, near waters. It is much branched, bearing long, scabrous, linear, acute leaves ; and large, purple, subsessile flowers ; with the divisions of the calyx subulate. Another species in drier places, in woods, the *G. tenuifolia*, is very similar, but lower growing, and with peduncles which are longer than the purple flowers. The *G. flava* of the second section, unlike the preceding, is perennial ; having nearly a simple stem, subsessile, lanceolate, pubescent leaves, either entire or toothed, the lower ones deeply so, with subsessile, large, yellow flowers like those of the Foxglove. In the corolla of several of these species there is often the rudiments of a 5th stamen.

In wet places and ditches, about the month of August, you will not unfrequently meet with the *Mimulus ringens*, with blue, ringent, almost personate flowers ; having the palate of the lower lip prominent, and the upper lip reflected at the sides. The calyx is also angular, with the summit 5-toothed ; the stigma thick, and bifid ; the capsule 2-celled, the seeds numerous and minute. This species is erect and smooth, with sessile, lanceolate, acuminate leaves, and axillary peduncles longer than the flowers. The *M. alatus* is very similar, but has quadrangularly margined stems, peduncles shorter than the flowers, and petiolated, broader leaves.

In *Pentstemon*, a peculiar genus of America, abounding in the western wilds and territories, there is a 5-leaved calyx (as in Foxglove) ; a bilabiate, ventricose corolla ; a *fifth* sterile filament longer than the rest, and bearded on its upper side ; and hence the name of *Pentastemon*. The capsule is ovate, 2-celled, 2-valved, containing many angular seeds. There are

two species not uncommon in the middle states, in dry fields, and stony grounds. The *P. pubescens*, producing its purplish blue flowers about June; the pubescent leaves are lanceolate, oblong, sessile, and serrulate; the flowers in a thin panicle; with the sterile filament bearded above the middle. The *P. lævigatum* is very similar, but smooth, with paler, later flowers, and is less common, except to the south.

The *Chelone*, more common than the preceding genus, at least the *C. glabra*, found in wet places, in flower from August to October, is distinguished from Pentstemon by the thick, short ventricose form of the ringent corolla, in which the sterile filament is shorter likewise than the rest; the anthers are woolly, and the seeds membranaceously margined. The flowers of the *C. glabra* are large and white, in dense spikes; the leaves lanceolate, oblong, acuminate and serrate.

** *Calyx 4-cleft.*

In wet meadows, about May and June, you will sometimes observe a very gaudy, low, unbranched plant of this class and order, to which some years ago, with its congeners equally characterized, I gave the name of *Euchroma*, nearly the vulgar appellation of Painted-cup (probably an Indian name, as is that of Red-bud, given to the *Cercis*). The common species, here alluded to, *E. coccinea*, has the leaves and fine *scarlet* bractes spread out, each into 3 wide divisions like fingers on the stretch. The corolla is inconspicuous. of a greenish yellow, and bilabiate, with the upper lip very long and linear, embracing the style and stamens; the calyx ventricose, 2 to 4-cleft; the anthers linear with unequal sized lobes, all of them cohering together into the form of an oblong disk; the capsule ovate, and compressed, 2-celled;

the seeds numerous, surrounded with a membranaceous inflated vesicle. The *Bartsia pallida*, of the White Mountains of New Hampshire, is another species of Euchroma, characterized by having entire narrow leaves, subovate, pale pink colored bractes, sometimes almost white, slightly toothed at the extremity; and the teeth of the calyx entire.

The *Epiphegus*, or Beech-drops, of the natural order OROBANCHEÆ, and formerly included in the genus *Orobanche*, may well be known, as its generic appellation implies, by its uniform parasitic situation near the roots, and beneath the shade of Beech trees. The flowers, on the same plant, are polygamous, or fertile and infertile, though not as in true monoecious plants reciprocally necessary to the perfection of the fruit, for the first flowers produced, for some time, are all perfect, and the latest developed flowers alone are sterile. The calyx is very short, 5-toothed (and so an exception to our section). The corolla of the infertile flower (yellowish with purple stripes) is ringent, compressed, and 4-cleft; having the lower lip flat; the corolla of the fertile flower minute, 4-toothed, and very deciduous; the capsule truncate, oblique to its axis, 1-celled, imperfectly 2-valved, and opening only on one side. This curious plant, thickly scattered, flowering about September, is entirely leafless, and destitute of verdure, repeatedly but simply branched, with the flowers distant and all over the stem.

CHAPTER XXII.

OF THE CLASS TETRADYNAMIA.*

In the plants of this class, known to you already as the Cruciferæ, and equally natural in the present artificial system, there are 6 stamens, arranged commonly in 2 sets, and of an unequal length; 2 being shorter than the other 4, in consequence of a small gland interposed betwixt their base and that of the germ. Unlike the plants of the simple sixth class, the flowers of this are easily distinguished by producing a calyx and corolla of only 4 parts, or in symmetry with the 4 longer, and more perfect stamens. The fruit also, as in *Didynamia*, alone, forms the distinction of the orders; but here the orders both belong to the same natural group, and are so closely related as to pass insensibly almost into each other. They are founded merely on the comparative length of the pod or silique; the first being termed Siliculosa, and the second order Siliquosa.

Four stamens, instead of 6, the ordinary number, appears to be the symmetrical proportion of this class; and constant examples of a number below 6 are not wanting in nature; as for example, in *Lepidium virginicum* there are only 2 to 4; and in *Draba caroliniana*, where there are also 2 of the 6 commonly wanting. The 2 other short stamens then with their glands, which seem to form a separate system in the cruciferous flowers, have been assumed, perhaps rather boldly, as so many interposed rudiments of other flowers; and it is indeed asserted, that instances have occurred of their so developing themselves. That a single stamen with its gland may be occasionally the type of a flower, is not so extraordinary a circum-

* From τέσσαρες, *four*, and δύναμις, *power*, the power of four.

stance as at first might appear, for we have uniform examples of this abridgment in the family of the *Euphorbias;* and, in that genus itself, the flower, till lately considered simple, is always a compound of one female individual without any perianth, and many masculine flowers, perfected progressively, consisting each of a mere jointed stamen, and its minute inconspicuous scale. That such are real flowers appears from the occasional occurrence of a calyx and corolla in connexion with the single stamen, and arising from the articulated point, of which the lower joint alone thus represents the whole perianth.

THE ORDER SILICULOSA.

In this order the pod is short, round, and convex; or circular and flat, approaching more to the nature of an ordinary capsule than the silique of the next order. Its diminutive size, however, is not always the most characteristic distinction which it presents for observation. In both kinds of fruit the pod is divided into 2 cells by a partition, and opens by 2 valves, having the seeds attached (when several), alternately, to either edge of the dissepiment, which at once removes this kind of fruit from the nature of the legume, or pod of the Pea tribe, for this, though furnished with 2 long valves, has no partition, and only a single suture, for the attachment of the seed. The partition of the silique, or long pod, of the second order of this class, is said to be parallel with the plane of the valves, and is nearly their breadth, allowing for their convexity; but, in several of the silicles of our present order, such as that of the Cress and Shepherd's-purse, the valves are not merely convex, but folded together, and so compressed as to appear keeled like a boat. In this case, the partition appears very narrow compared to the whole breadth of the silicle, and, is said,

very truly, to be transverse, or as it were in an opposite direction to that of the dissepiment in the silicle. One of the most remarkable examples, though deviations from the ordinary character of the capsella or silicle, is that of the *Psychine*, so named from *Psyche*, the Butterfly, in allusion to the fruit which instead of 2, presents constantly 3 cells, and 3 broadly carinated valves, to the silicle. The same number of valves, though not constant, may often be observed in the fruit of the common Candytuft (*Iberis umbellata*). In *Biscutella*, the dissepiment is reduced to a mere axis of attachment, to apparently, 2 different circular flat silicles, united as one fruit by their edges merely, and hence the name, which signifies 2 little shields.

One of the most common weeds of this order, though worthy of examination, is the Shepherd's-purse (*Thlaspi Bursa-pastoris*), deriving this specific name from the peculiar form of the capsule. The plant has but little to recommend it, being an unsightly annual, running, only too quickly, over neglected gardens and wastes, and is one of those plants, like the Chickweed, and the Black Nightshade (*Solnum nigrum*), which have made themselves denizens of the whole habitable world. In the United States it is quite common on the banks of the Mississippi, and the more distant Missouri. Its radical leaves are pinnatifid, with the divisions toothed, and sometimes bent in an arch. The flowers are very small and white. The silicle or *capsella*, which gave name to the plant itself amongst the ancient botanists, is triangularly obcordate, but without a keel or empty margin; and the cells, each, contain a multiplicity of minute seeds. Such ought to be the description of the genus, which would then probably include no other plant; but at present, by many, the genus is very unphilosophically constructed, so as, in reality, to exclude our Shepherd's-purse, and

embrace other plants quite dissimilar, which commonly make a nearer approach to the Cress or *Lepidium* by their rounded and carinated silicles, but differ also from that genus by their multiplicity of seeds.

One of our very earliest plants, the *Draba verna*, in flower often in March, in the middle states, belongs to this order. It is an annual, bearing small white flowers, and the plant, of very diminutive size, bearing a few lanceolate, short, hairy, somewhat serrated leaves, and naked scapes, with a terminal corymb of flowers, which, in character with the genus, are succeeded by elliptic-oblong silicles, rather flatly compressed, and the cells containing many minute seeds without margin. The cotyledones, here, indeed, a desperate microscopic character, are also brought in, as on many other occasions in this class, to afford an additional character, and they are said to be *accumbent;* that is, with the back of one of the seed-lobes applied to the curved radicle. The cotyledones are also said to be *incumbent*, when their edges are applied to the radicle. In this, and the next species, *D. caroliniana*, the petals are very distinctly cleft. In the latter, the silicle is so long as to appear linear-oblong, exceeding in length its supporting pedicel.

In *Lepidium*, or Cress, the silicle is roundish-ovate, or partly obcordate, with the valves carinated and bursting open; and each cell contains but 1 seed. The cotyledones are incumbent.

In the Moonwort (*Lunaria*), sometimes called Honesty, the silicle is roundish-oval, quite flat, pedicellate or stipitate, and as large nearly as a cent. This is not an uncommon garden plant, producing heart-shaped, indented, acute leaves, the lower ones petiolated; the flowers, nearly as large as those of the Wall-flower, are of a fine purple; and 2 of the leaves of the calyx are swelled out or gibbous at the base.

The Candytuft of the gardens (*Iberis*) is at once known by its irregular corolla, in which the 2 outer petals are larger than the 2 others.

THE SECOND ORDER SILIQUOSA.

The plants of this order are known by producing a long, slender, linear pod, as in the example of the Wall-flower (*Cheiranthus*), which has a flattish, or convex-sided, long pod, containing many flat seeds, with a winged margin ; and a calyx whose 2 opposite leaflets are gibbous at the base, occasioned by a glandular toothlet on each of these sides of the germ. The Stock-Gillyflower, among others, also belongs to this showy genus, several of which are remarkable for the beauty and fragrance of their flowers. It is only distinguishable from the true *Erysimum*, by its round, instead of quadrangular pod.

The Radish (*Raphanus*) has a very peculiar, cylindric, jointed, and swelling silique, which never spontaneously opens ; and has a pair of glands between the shorter stamens and the pistil, and a second pair between the longer stamens and the calyx.

In the genus *Arabis*, or Wall-cress, some of them common annuals, with white flowers, the silique is linear, with the valves flat, and 1-nerved. The seeds disposed in a single row ; the cotyledones accumbent ; and the calyx erect. Most of the species grow in dry fields or rocky hills, and are in flower from April to June.

In *Hesperis* (Dame's-violet or Rocket), of which we have a common garden species (*H. matronalis*), with purplish or white and fragrant flowers, very like to those of the Stock-Gillyflower ; the silique is somewhat quadrangular, or 2-edged ; the stigma nearly sessile, and formed of 2 connivent lobes ; the

cotyledones flat and incumbent, with the calyx closed (or not spreading), and gibbous at the base. Of this genus there is one small flowered, inodorous species (*H. pinnatifida*) in many parts of the valley of the Ohio. The leaves are acutely serrate, the uppei ones lanceolate, the lower often pinnatifid-lyrate. This plant is very nearly related to *Sisymbrium*.

In *Sinapis*, or Mustard, the silique is almost cylindric; the seeds globose, arranged in a single row; the calyx spreading; and the cotyledones conduplicate or folded together. Most of the species are common weeds, but one of them is used in salad, and another affords our common warm condiment of that name. The genus differs but little from that of the Cabbage (*Brassica*); but in the latter the calyx is erect.

Isatis, or Woad, used by dyers, though placed here, belongs more properly to the Siliculosa. It bears lanceolate, 2-valved, and rather short siliques, of only one cell, in consequence of abortion, and containing but 1 seed; the valves are also carinated or keeled, like a boat. The flowers are yellow, and numerous; the stem-leaves amplexicaule or embracing, and sagittate or arrow-shaped.

For convenience and affinity, we find here appended to the close of this class the genus *Cleome*, of the natural order Capparides. It bears a 4-leaved, spreading calyx, which is not deciduous; and 4 unequal, long clawed petals. The stamina 6, unequal, often connected at the base; and the silique stipitate in its calyx, consisting of but one cell, with the curved, shell-formed seeds attached to a filiform marginal receptacle, in which character, of the silique and seed, this, and the following genera, essentially differ from the Cruciferæ. Most of them have a heavy, disagreeable odor, and are possessed of deleterious properties, which is not the case with the other plants of this class.

The new genus *Polanisia*, lately separated from *Cleome*, has a similar corolla with that genus; but from 8 to 32 stamens; and a silique of an oblong, linear form, and sessile in the calyx. This plant is very heavy scented, and viscid, with ternated leaves; and is found, though not very commonly, on the sandy shores of lakes and rivers.

The curious *Stanleya*, of the banks of the Missouri and of Florida, where there is also an additional species, appears to unite the CRUCIFERÆ and CAPPARIDES almost uninterruptedly; for with the flower, partly, of *Cleome*, and its stipitated fruit, it presents a complete dissepiment in the narrow and long silique, and has oblong seeds, with flat cotyledones. The *S. pinnatifida* produces thick, and glaucous, pinnatifid leaves, not much unlike those of Sea-kale; its flowers are bright yellow, in long and crowded racemes; with a very spreading yellow calyx; long, erect, conniving petals; and 6 stamens.

CHAPTER XXIII.

OF THE CLASS MONADELPHIA.

THE plants of this class are only to be known from those of the other simpler classes by the combination or union of their filaments into one body, and hence the name of *Monadelphia*, or one brotherhood. This character, sometimes ambiguous or slight, as in *Geranium* and *Pelargonium*, is not calculated to bring together an uniform and natural group of plants. Though one of the orders, at least, contains a natural assemblage of the strictest symmetry; this is the order POLYANDRIA. The orders are formed without any reference to the pistils or fruit, and un-

like any of the preceding, secondary divisions, upon the number and disposition of the stamens.

THE ORDERS PENTANDRIA AND DECANDRIA.

In Pentandria is now placed the Passion-flower (*Passiflora*), the type of a peculiar natural order of the same name. This genus, of scandent or climbing plants, is one among so many others peculiar to America, but more particularly to the forests of the southern continent. Their immensely long, and often woody branches attain the summits of the loftiest trees, or trail upon the ground, adorned with perennially green or falling leaves, sometimes palmate or lobed like fingers, in others like those of Laurel. They sustain themselves by means of undivided tendrils; and send out a long succession of the most curious and splendid flowers, of which no other part of the world offers any counterpart. Some of these flowers are extremely fragrant, and succeeded by pleasant tasted, acidulous fruits, resembling berries or small cucumbers.—The character of the genus is, to have a 5-parted, colored calyx; 5 petals inserted upon the calyx; the nectary or lepanthium, a crown of filaments; and the fruit a pedicellated *pepo*, or berry. There are 3 species indigenous to the United States, commonly growing in light and dry soils, near the banks of rivers, from the lower part of the states of Delaware and Maryland, to the south and west indefinitely. The *P. lutea* has small, greenish yellow flowers of but little beauty, and cordate, obtuse, 3-lobed leaves. The *P. incarnata* has conspicuous reddish or pale colored flowers, and 3-lobed, acute, serrated leaves, with 2 glands on the petiole, and, as in many other species, furnished with a 3-leaved involucrum, almost similar to an additional calyx.

OF THE ORDER HEPTANDRIA.

In this order comes the genus *Pelargonium* of the Cape of Good Hope, or green-house Geranium. The flowers are irregular in their proportions; there are 10 filaments, but only 7 which bear anthers; the upper, larger segment of the calyx communicates with a grooved nectary, which often proceeds a considerable distance down the peduncle, and at its termination has the appearance of an articulation. The fruit, as in the following genus, and most others of the natural family GERANIACEÆ, consists of 5 pericarps with long awns, united to lengthened receptacles; when mature, they separate elastically from the summit to the base, with the awns then spirally twisted, and internally smooth. Of this splendid, and much admired genus, there are now more than 350 species, besides many varieties, the effect of accident and cultivation Most of them are fragrant, and form straggling shrubs; a few die to the ground, and come up and flower periodically; but most of them are in perpetual leaf.

DECANDRIA.

Geranium, properly so called, only differs from *Pelargonium* in the equality of its calyx and corolla; and in producing 10 perfect stamens, of which the 5 alternate ones are longer, and have nectariferous glands at their base. Of this genus, our most common vernal, large flowering species, in woods, is the pale purple flowered *maculatum*, which bears roundish, 3 to 5-parted gashed leaves, with the upper ones opposite and sessile; the petals are entire; the stem angular and forked; the root tuberous and perennial.

THE ORDER POLYANDRIA, *or family* MALVACEÆ.

After inspecting the flower of the Hollyhock or Mallow, you will need no further definition of a Malvaceous plant, or be at a loss for reference and natural alliance wherever you may meet it. The stamens are numerous, with their filaments united into a column in the centre of the 5-petalled, but adhering corolla; to these they are also firmly ingrafted. This peculiar union of the filaments gave rise to the ancient appellation of COLUMNIFERÆ, by which this natural order was once known. In the centre of this hollow column of stamens, when slit open, you will find the styles disposed in another bundle, though not commonly ingrafted together as the filaments; these vary, from 5, to an indefinite number, and always accord either with the number of the separate pericarps, or the capsular cells. The calyx is often double, and sometimes alone affords generic distinctions. In this family are included some of the most useful as well as splendid productions of the vegetable kingdom; such are the Cotton (*Gossypium*): the Silk-cotton, or *Bombax*, a splendid genus of tall evergreen tropical trees, also affording a long and soft silky cotton: the *Carolinea* of the West Indies, remarkable for the vivid colors and magnitude of their flowers: the *Barringtonia* of the tropical islands of the Pacific, a tall and magnificent tree, full of large and most beautiful flowers, of a brilliant white and purple. But the most wonderful of all productions, in the singularity of its flower, is the Hand-tree of Mexico (*Cheirostemon*), whose spreading, linear stigmas, inclined to one side, not unaptly resemble the hand of a monkey. The largest and longest lived tree in the world, is the *Adansonia*, or Sour-sop of Africa, the base of whose trunk has been found to be of the enormous diameter

of 25 feet, and sufficiently large, when hollow, to afford shelter for several negro families. Adanson states that they endure for 6 or 7 centuries; but Professor Smith, who fell an untimely victim in the Congo expedition, thinks there is reason to believe that this tree is of rather a quick growth, from the softness and thickness of its alburnum and woody rings.

Among the most splendid productions of this family, indigenous to the United States, is the genus *Hibiscus*, of which most of the other species are tropical. They are remarkable for the magnitude and elegant colors of their flowers, which appear very similar to those of the Hollyhock of China. This genus produces flowers with a double calyx, the exterior of many (commonly narrow) leaves. The stigmas and styles only 5; agreeing with the 5-celled capsule, each cell containing many seeds. By careful dissection it will be found, that each dissepiment of the cells, of the supposed, single capsule, is divisible; or, that the apparent cells are so many distinct small capsules. One of our finest, and most common species, is the *H. palustris*, a tall perennial, growing in marshy grounds, and flowering about August. The leaves are broadish-ovate, toothed, and often 3-lobed, with a short and whitish down or tomentum beneath; the peduncles are axillary, distinct from the petioles, and articulated circularly above the middle. One of our common ornamental shrubs is the *Althæa frutex*, or *H. syriacus*, with both double and single flowers, white or purple, with a deeper colored ring in the centre, as is common in the genus. It may be known, at once, by its shrubby stem, and wedge-shaped, smooth leaves, divided at the summit into 3 lobes.

In *Althæa* the calyx is also double, the exterior 6 to 9-cleft. The capsules are numerous, 1-seeded,

and arranged in a circle. The *A. officinalis*, or Marsh-mallow, with remarkably soft tomentose leaves, entire, or 3-lobed, is sometimes met with on the borders of salt-marshes, apparently indigenous.

Malva, or Mallow, has the exterior of its 2 calyces mostly 3-leaved, and the capsules precisely as in *Althæa*.

In *Lavatera*, of our gardens, the generic character only differs from *Malva* in having a trifid exterior calyx.

In the Cotton, *Gossypium*, the exterior calyx is large, and really resembles an involucrum, being composed of 3 broad, heart-shaped, deeply serrated leaves. The calyx is cup-shaped, and only 5-cleft towards the summit. The flowers are somewhat campanulate, white or yellow, with a deep purple base. The 5-cleft capsule, preceded by 5 styles, contains, in each cell, several rather large, brown, or greenish, coated seeds, each surrounded by a mass of compacted cotton, which arises from this coating. The leaves are generally 3 to 5-lobed. The species are originally tropical ; but one of them can be somewhat profitably cultivated up to the line of the state of Delaware ; the cotton of warm countries is, however, most esteemed.

In *Sida*, and a few other genera, the exterior calyx or involucrum, as it really is, is wanting, there being but 1, 5-cleft, simple, and often angular calyx. The styles adhere so as to appear almost single. The capsules are numerous, arranged in a circle, each 1-celled, dehiscent, and 1 to 3-seeded. The flowers are often yellow, and rather small. Our but too common species in gardens and wastes, is the *S. abutilon*, which grows rather tall and large ; the leaves are softly tomentose, roundish-cordate, acuminate, and toothed ; the peduncle shorter than the petioles ;

the capsules 15, truncate, hairy, and each opening with 2 beaks or points. The seeds of this plant have been employed as a substitute for Coffee, which they resemble considerably both in texture and taste. In Virginia and the southern states there is a Diœcious species (*S. dioica*), which, with another of very tall growth, formed once the genus *Napæa*. These have abundance of small white flowers, and palmately lobed leaves; in *Napæa* smooth; in *S. dioica* scabrous. In both, the peduncles produce many flowers in a kind of corymb, and 10 capsules in a calyx. This genus is very numerous in species, many of them being found in South America and India.

CHAPTER XXIV.

OF THE CLASS DIADELPHIA.

This class, like the preceding, includes, principally, plants of a single very natural order, with which you have already been made acquainted, as the Papilionaceæ, or more properly Leguminosæ, the character of the fruit, the *legume*, being more uniform in this tribe, than the Papilionaceous, or Pea-blossomed flower. Its ostensible character, as the name of *two brotherhoods* would imply, is to have flowers, of whatever kind, with the stamens disposed in 2 bodies of united filaments. It will be found, however, that there are several exceptions to this rule in examining the plants referred to it, particularly in the Leguminosæ. But here, justly enough, no doubt, all affinity pleads for their detention in the same arrangement, whatever it may be, which includes the rest of the same natural family; though this rule is violated against our Wild Indigo, and many other Leguminosæ of

New Holland, which, possessing separate filaments, are forcibly, as we may say, detained in the simple tenth class. Nor are exceptions wanting in other parts of this artificial class, for in *Corydalis cucullaria* there are 6 distinct filaments. In very few of the genera is there any thing like an equal proportion in the 2 bodies of filaments. In the whole order of the LEGUMINOSÆ, there are only about 3 examples of the stamina arranged in equal sets of 5 each; these are the genera *Smithia*, *Sesbania*, and *Æschynomene*. In all the rest of this great natural order, the stamina are either wholly combined into one body or cylinder of ingrafted filaments, or with but one thread separated from the other 9, which are combined in the second body.

The orders, as in Monadelphia, are founded on the number of the stamina, the classical or principal arrangement having regard only to the peculiar and remarkable disposition, of the binary ingraftment of the staminiferous filaments. The only orders yet discovered are 4; namely, Pentandria, Hexandria, Octandria, and Decandria.

The only plant comprised in the first of these orders, Pentandria, is a very curious and highly ornamental genus, peculiar to the prairies or savannahs of the western and southern states and territories of the United States, formerly included in *Dalea*, but very properly separated by Michaux, and now known as *Petalostemon*, expressive of its most remarkable trait, that of producing its petals, 5 in number, and uniform, from the same tube of combined filaments, whose other threads produce anthers. Indeed, no other petals are produced but these, which thus hold the place of sterile anthers. The 5-cleft calyx, which, like Clover, nearly covers the very small, 1-seeded legume, is characteristic also of Dalea; but in Dalea

there are 10 perfect anthers, and a papilionaceous, 5-petalled corolla. The Petalostemons are perennials, with clustered, and commonly simple, low, herbaceous stems, terminating in cylindric dense heads of white, reddish purple, or pink flowers, which retain their color in the herbarium in a very extraordinary degree, particularly the *P. violaceum*, which, after years of drying and death, seems still as bright as when the living ornament of its native plains.

In HEXANDRIA, of this class, you will find the 2 genera, *Corydalis* and *Fumaria*, formerly united, and now making part of a natural order, named, from the better known genus, FUMARIACEÆ. They have both a 2-leaved calyx, and a corolla of 4 petals, with 1 or 2 gibbous cavities at its base. In the Fumitory, however, the silicle is nearly round, containing but a single seed, and never spontaneously opening. This is a common annual weed in gardens, having a weak and diffuse stem, and compound leaves dividing in a ternary manner.

In *Corydális* the silique is 2-valved, compressed, oblong, and many-seeded. Of this genus we have 6 or 7 species, with red, white, or yellow flowers, and most of them early flowering and very elegant plants. I will merely quote 2 of the species, which are perennial, and commonly in flower betwixt April and May. In both these, inhabitants of our unaltered, rich, shady, and often rocky woods, the 6 filaments present an exception, as we have noticed above, to the character of the class, in their entire separation to the base. The first and best known is the *C. cucullaria*, ridiculously called Dutchman's breeches, from the 2 straight, acute, divaricate spurs, or projecting gibbosities at the base of the corolla. This plant, which grows together in considerable quantities, has a small, scaly, bulbous root; finely twice decompounded, elegant,

13*

narrow leaves, of a pale and delicate green; from the bosom of these arises a low scape, bearing a 1-sided or secund, simple raceme of white, singular looking, pendulous flowers. A recently discovered species, very similar in many respects, but found in a northern range, from the forests of Massachusetts to Canada, and so called *C. canadensis*, differs essentially from the preceding in producing spherically tuberous roots; finer and narrower leaves; also white flowers with obtuse spurs, and simple racemes. This plant I have met with in the shady woods a few miles from Bellows' Falls.

In the order OCTANDRIA is arranged the genus *Polygala*, or Milk-wort, forming the type of the natural family, POLYGALEÆ. The United States contain nearly 20 species, all of them low and herbaceous, having small leaves, and cylindric heads or spikes of flowers of various colors, as red, white, and more rarely, yellow and blue. At the Cape of Good Hope there are several very elegant shrubby species, generally with reddish purple flowers. All of them agree in producing a 5-leaved, irregular, persistent calyx, of which 2 of the leaflets are wing-shaped and colored, the 5th resembling the keel of the *Leguminosæ*, and often terminated with a villous tuft or crest. The capsule is obcordate, 2-celled, and 2-valved. The seeds few and pubescent. One of the most useful species of the genus is the *P. senega*, or Seneka Snakeroot, with thickish tortuous roots, sending up a cluster of simple smooth stems, with many alternate, ovate, lanceolate leaves, and spiked racemes; the calycine wings are white and orbicular, and the capsules elliptical. But the *paucifolia*, or few-leaved, is the most elegant and highly colored species in the United States. It forms considerable beds or colonies in the vicinity of Fir woods, flowering in May and June, and

is particularly abundant in New England and Canada. The stems are simple, and only 3 or 4 inches high, bearing a tuft of broadish ovate leaves, from amongst which arise 3 or 4 large and beautiful purple flowers, with a conspicuous crest at the extremity of the lower keeled petal, but at the root will be found, as in the species called *rubella* or *polygama*, a few apterous fertile flowers. In the middle and southern states, in the swamps of the pine barrens, may frequently be seen, in flower from June to October, the *P. lutea*, remarkable for its beautiful cylindric heads of orange colored flowers; in this the lower leaves are spathulate, the upper ones lanceolate; the calycine wings are ovate and mucronate, and the bractes shorter than the flowers. Our most common species, however, is the *P. purpurea*, formerly confounded with the *P. sanguinea*, a much rarer species. In this the stem is so branched that the flowers all come to the same summit, so as almost to form a corymb; the leaves are alternate, rather numerous, and oblong-linear; the spikes cylindric, oblong, obtuse; the flowers beardless; the calycine wings, cordate-ovate, twice as long as the capsule. But it is unnecessary to adduce any more species, they are common in every swamp, wood, and meadow.

The order Decandria embraces exclusively the natural order of the Leguminosæ, and is divisible into 2 principal sections; in the first are comprehended the monadelphous genera, or those, in which the filaments are all connected into a tube; and the first genus which presents itself in this division, is one of great singularity, called *Amorpha*, from its remarkable defect of petals, the corolla consisting of nothing more than an ovate, concave vexillum; the wings and keel being entirely wanting. The calyx is partly campanulate, and 5-cleft. The legume 1 or 2-seeded, fal-

cate or sickle-shaped. The genus has been called abroad, I believe, Bastard Indigo, it is peculiar to the United States; but confined exclusively either to the southern or western states, and consists, at present, of about 6 species, all shrubs, or woody rooted perennials, growing either in prairies or by the banks of rivers. They have elegant small, and pinnated, smooth or hoary leaves; and the flowers, commonly blue, are collected into clusters of long, terminal, rather dense spikes. The pods or legumes are covered with resinous, aromatic, but rather fœtid glands. Our commonest species, often in gardens, where it is cultivated for ornament, is a smooth shrub about 6 feet high, with dark blue flowers, and with only one of the teeth of the calyx acuminated, and the rest obtuse.

The Lupin (*Lupinus*), which you meet in every garden, has all its filaments likewise united; but its generic mark is to have anthers of 2 forms; 5 of them oblong, and 5 round. The calyx is also bilabiate or 2 lipped, and the legume coriaceous, or of a leathery or cartilaginous texture, and torulose, having protuberances which mark the lodgement of each of the seeds. The species are mostly annuals, 2 of the American kinds only being perennial; namely, *L. perennis* and *L. nootkatensis* from the North-west Coast. With 2 or 3 exceptions of simple leaved species, they have digitated or fingered leaves, with the leaflets nearly arranged in a circle. The flowers are in spikes, of various colours; as white, yellow, blue, and variegated. The white Lupin is cultivated in the South of Europe for food. After being made acquainted with the genus, it is unnecessary here to describe the specific character of our rather common and beautiful blue perennial, digitate leaved Lupin, as you cannot confound it with any other native species, when you have, from appearances, such as its copiously running roots, ascertained

it to be of perennial duration. You will meet with it in flower from May to June, and it always prefers sandy woods. In the southern states there are 2 very remarkable biennial species, *L. villosus*, and *L. diffusus*, with entirely simple, oblong, silky, or villous leaves; and producing long showy spikes of variegated purple flowers.

Stamens Diadelphous.

In this section we shall commence with the Pea (*Pisum*), which is not very readily distinguished in generic character from the *Lathyrus* or Vetchling. It differs, however, in the calyx; having the segments all equal, and leaf-like; the vexillum has also 2 protruding plaits. The style is compressed and carinate, with the upper side villous; the suture of the legume is likewise naked. The native country of the cultivated pea (*Pisum sativum*) is said to be Alsace and other parts of Europe; yet it is now difficult to ascertain whether it be really indigenous, or only naturalized in such places.

The *Lathyrus*, Vetchling or Sweet Pea, has a calyx with the 2 upper segments shortest. A flat style, villous on its upper side and widening above. All the species have a strong resemblance to the Pea. One of the most beautiful, as well as fragrant annual species, is the commonly cultivated Sweet Pea (*Lathyrus odoratus*). The Everlasting Pea (*L. latifolius*) is a very common denizen of old gardens, being a large and diffuse perennial, attaching and supporting itself. like all scandent plants, by means of the branching tendrils terminating its single pair of broad leaflets, and which twining economical processes are, in fact, reasoning from strict analogy, the abortive rudiments of other sets of leaves, though never developed. Indeed, tendrils generally, of which there are abundance in

this family of plants, form no absolutely distinct class of organs, their function, on the contrary, is divided, or distributed among various other organs; sometimes they are elongated stipules, processes which appertain to the system of the leaves, such are the tendrils of the *Smilax*, or Green Briar. In the *Gloriosa superba*, the points of the leaves themselves are lengthened out into tendrils. In the Cucumber, and Pumpkin, on a careful comparison, it will be seen that the tendrils correspond in divisions with the number of the principal vessels in the opposite perfect leaf, and, that they are only imperfect leaves, and merely lack the connecting cellular tissue. So in many aquatic plants, the submersed leaves often present numerous capillary divisions, while the emerging leaves are entire, or merely notched, serrated, or lobed. In the Grape Vine (*Vitis*) the abortive peduncle forms the tendril, and may not unfrequently be found bearing a small portion of fruit. In the *Calytrix* of New Holland, the petals themselves terminate in long hairs or filaments, not very dissimilar to tendrils. In *Clematis virginiana*, one of our commonest climbers, the petiole, producing perfect leaves, entwines itself like an ordinary tendril. In the volubulous plants, such as many species of *Convolvulus*, &c. the stem itself partakes of the clasping character of the tendril. This means of attachment, puts on the nature of the root, in some measure, in the *Cissus hederacea* or 5-leaved Ivy, as its extremities, like the radicant fibres of the Ivy, obtain a firm attachment to the trunks of trees and the sides of walls; and, like roots, these radicant tendrils avoid the light, and seek opaque and cool bodies. We see in all this secondary contrivance of nature, in the character of the tendril, as in many other subjects of the vegetable kingdom, an admirable, yet variable application, according to circumstances, of economy to

the support and protection of trailing plants. No means of attaining the proposed end are neglected; a resource ever fruitful, ingenious, and simple, presents itself to our admiration, every instant we reflect and observe the structure of plants.

But to return to our immediate subject. There is a second genus, that of the Vetch (*Viccia*) hardly to be distinguished from *Lathyrus*, and approaching about as near to that genus, as it does to *Pisum* or the Pea. The following is its generic character. A calyx with the 3 inferior segments straight and longer. The vexillum notched or emarginate. The style transversely bearded beneath the stigma. Of this genus, so abundant in Europe, we have very few species, and some of them alike common to both continents; such is *V. cracca*, chiefly of the northern states, bearing dense spikes of downwardly inclined, blue flowers of considerable beauty, with numerous pubescent, lanceolate leaflets; and half-arrow shaped stipules, or foliaceous processes, mostly entire. It is found commonly in meadows and thickets, in flower about midsummer.

The genus *Ervum* (Tare and Lentile) is hardly to be known from *Viccia*, except by its capitate stigma, which is in every direction pubescent. For the rest, they have the general look of diminutive vetches. The Lentile (*E. lens*), used in soups, and other ways in Europe, is one of the few redeeming pledges of utility in this mean looking genus. The lentile is of the form of a flattened spheroid, or lens of a telescope, and hence the term now introduced into the arts from the name of the seeds of this plant.

In the genus *Astragalus*, which abounds in Siberia and the western territories, the legume is always more or less 2-celled, with the inferior suture reflexed. They are herbaceous, and, in some species, almost

shrubby plants, with pinnated, rarely trifoliate leaves, devoid of tendrils or weak stems, being erect or diffuse; the flowers are red, or yellow, more rarely blue. In *A. tragacanthus*, which affords the gum of that name, and a few others with suffruticose stems, the costa or mid-rib of the old leaves remain, and become transformed into long and crowded spines.

In the Clover (*Trifolium*), the flowers are quite small, and crowded together in roundish or oblong heads; and the legume is so diminutive as to be concealed within the calyx, without valves, and each containing 2 to 4 seeds. In the ordinary Red Clover, *T. pratense*, the flower by the natural engraftment of the petals presents the anomally of a monopetalous corolla.

The genus *Lespedeza*, separated from *Hedysarum* or *Saintfoin*, is distinguished by its lenticular, 1-seeded, unarmed, loment, or unopening legume. The 5-parted calyx has also its segments nearly equal. Of this rather elegant flowered genus there are a considerable number of species; they are either tall or diffuse herbaceous plants, with purplish flowers, and trifoliate leaves subtended by minute bristly stipules.

Hedysarum bears a loment, commonly hispid, of several 1-seeded, truncated, flattened joints. These, which abound in all parts of the United States, have nearly the habit of the preceding genus, but that the plants and their leaves are often larger; and in Europe, including the *Saintfoin*, there exists a section with more showy flowers, bearing pinnated leaves; of these, the *H. alpinum* is also a native of the northern regions of the United States and Canada.

In *Æschynomene*, principally a tropical genus, but of which one species occurs on the banks of the Delaware, the stamens partake of the extraordinary

character of dividing themselves into 2 equal setts. The calyx is also bilabiate; the loment compressed, having one of its sutures straight and the other lobed; the joints truncated, and each 1-seeded.

The Kidney-bean (*Phaseolus*) has the keel of the corolla with the stamens and style spirally twisted. The legume is likewise compressed and falcate, with the seeds consequently somewhat flattened, and reniform or kidney-shaped. By the first and most important of these generic characters you will readily perceive a difference betwixt the flowers of this genus, as in the Scarlet-runner (*P. multiflorus*), for example, and the Lima-bean, with others now cultivated, which belong to the genus *Dolichos*, where none of this twisting of the stamens and keel is to be found; and, in addition, 2 callosities at the base of the vexillum compressing the sides of the keel. We have, however, another genus almost intermediate between these two, and which, in turn, has been referred to both; but it appears to constitute a distinct genus, now termed *Strophostyles*, in reference to the twisted character of the keel and its included organs, a character possessed in common with *Phaseolus*, but the legume is cylindric, as well as the seeds, which are, nevertheless, partly reniform. This little kindred tribe are all trifoliate plants, with showy flowers, and weak, twining, or prostrate stems. Many of their seeds and unripe legumes form important articles of diet, and continue longer in season than any other pulse.

In shady thickets, and on river banks, where the soil is black and fertile, may often be found another twining plant of free growth, peculiar to the United States, and forming of itself a particular genus, called *Apios*. Its roots are strings of oblong cylindric tubers, called, sometimes, Pig-potatoes, and Indian potatoes, as when roasted or boiled they have partly

the mellowness and flavor of ordinary potatoes; and, as the roots of the *Lathyrus tuberosus* are eaten in Holland, so these, very similar tubers, made also an ordinary part of the vegetable food of the aborigines. The leaves are pinnated, each consisting of 5 or 7 broadish leaflets, from the axils of which, about July and August, come out abundance of short and dense clusters or racemes of purplish brown, slightly fragrant flowers. The calyx is partly 2-lipped, truncated, and 1-toothed; the keel falcate, reflecting back and impressing the summit of the vexillum. The germ is sheathed at its base; the legume coriaceous and many-seeded.

The *Colutea*, or Bladder Senna, is a beautiful genus of exotic shrubs, well known by their inflated, thin, bladder-like, many-seeded legumes; and having yellow or reddish flowers.

The genus *Robinia*, or Locust-tree, is one of the prevalent ornaments of our forests and mountain tops, in the milder latitudes; they are also as commonly cultivated, more particularly the *R. Pseudacacia*, or common Locust-tree, so valuable for its timber. They have all pinnated leaves, and pendulous racemes of beautiful red, or white, and sometimes fragrant flowers. These consist of a campanulate, 4-cleft calyx, with its upper segment bifid. The vexillum is roundish, expanded, and reflexed; the legume flat and long, containing many small, compressed seeds.

In *Medicago*, of which Lucerne is a species, the keel of the corolla is bent from the vexillum; and the legume is compressed and spiral, so as to resemble the shell of a snail.

To this family also belongs the Indigo-plant (*Indigofera*), having falcated, unopening, angular, small legumes; and also the Liquorice (*Glicyrrhiza*), whose root is employed in commerce and medicine.

The largest flowered plants of the LEGUMINOSÆ, in the United States, are the *Clitorias*, of which the vexillum is so large as to cover the wings of the corolla. These have a few blue flowers, and ternated leaves; with narrow, many-seeded pods.

The genera formerly referred to, the now abolished class, POLYADELPHIA will be found indiscriminately arranged, according to their characters, in Polyandria; such are *Hypericum*, and a few others.

CHAPTER XXV.

THE CLASS SYNGENESIA.*

THE character of this class and its orders have already been explained in the 8th and 9th chapters of this work; to which I would refer you, on this, as on other occasions, when you entertain any doubts on the arrangement of your plants, and the respective place they may occupy in the present system. The principal character of SYNGENESIA, as its Greek name implies, is, *the union of the anthers;* but as there are examples in the Violet, Balsam, and many of the Cucumber tribe, of a somewhat similar union of anthers, though they do not now form part of this class, nor bear any natural relation with it, another, or second character must be present also in connexion with the ingrafted anthers; and this is the *compound* character of the flower, which well entitles it, in the natural method of arrangement, to the name of COMPOSITÆ, or CORYMBIFERÆ. A Sunflower or Dandelion, for example, is not a simple individual, like a Lily or a Pink; but a crowded cluster, or condensed corymb, made up of a considerable number of florets,

* From σὺν, *together*, and γένεσις, *generation*.

or little flowers, individually, as perfect as those of a larger kind, each having its distinct, flat, or tubular, 5-toothed corolla; a set of stamens with 5 distinct filaments, terminating in a hollow tube of 5 connected anthers, through which passes a style, either single, or divided into 2 stigmas; and at the base of the whole an adhering germ with one seed; its summit often crowned with a calycle, or small calyx, termed the *pappus* or *down;* as such it often becomes with the maturity of the seed, though it also not unfrequently presents itself in the less equivocal character of a definite number (properly 5 or 10) of minute scales, or chaff-like leaves. Of this gradual evolution of the calyx, commonly the preceding part of the perianth, we are not in want of examples in other families of plants; the same thing takes place in *Valerian*, the flowers appearing to come and go without the protection of the calyx, which at length becomes obvious enough on the summit of the seed, in the form likewise of a plumose radiated crown or pappus, now only calculated to waft abroad the seed. The seed in the COMPOSITÆ, though often probably mistaken as such, is not in reality naked. It is a species of caryops or chartaceous pericarp, on maceration in water sometimes divisible, though imperfectly, into 5 or more little valves, and includes always a single seed possessed of the usual integuments. Two seeds, at least might be expected as succeeding to the deeply bifid style, or 2 stigmas of these florets. We may then again, as in so many other instances in the vegetable kingdom, presume an hereditary abortion, of great constancy, as prevalent in this very natural class. We have a stronger example of this abridgment of vegetable resource in the POLYGONEÆ (as in the Dock, Rhubarb, and Buck-wheat plant), where the 3-sided pericarp, preceded by 3 styles, only af-

fords 1 seed ; and in *Statice*, or Sea-Lavender, 5 distinct styles are succeeded by only a simple seed, in a valveless capsule. Yet in the order NECESSARIA of our present class, the maximum of all possible abortion is attained in the discal florets; for though to all appearance as well formed as usual, they never produce any perfect seed, and have indeed only the rudiments of the caryops itself. The want of sufficient space and nourishment appears here to be the operative cause of this abortion, for the radial or external florets possessing room, and merely styles and corollas, are amply fertile, and receive their pollen or its influence from the discal abortive florets, whose pistils perfect nothing. Abortion of a less obvious and constant kind is prevalent in many of the perennial plants of this class; for amongst thousands of Aster, Solidago, and Gnaphalium flowers, and many others, scarcely any seed is ever perfected. The sap, immediately after the late period of flowering, ceasing sufficiently to ascend the stem, appears principally engaged and retained in the warmer bosom of the earth to circulate in the root and numerous shoots which it now produces.

THE ORDER ÆQUALIS.

In the first order, termed ÆQUALIS, the flowers are all equally perfect, or possessed of both stamens and style ; but they are obviously divisible into 2 sections from the form of the florets. In the first they are all flat, ligulate, or strap-shaped ; in the second section the florets are all tubular or uncloven, for the flat florets are certainly nothing more than florets laid open, and thus putting on the unusual appearance of single petals or half florets. We shall, as usual, commence with the *ligulate flowers of the order* ÆQUALIS.

No more familiar example first offers itself for our examination than the common Dandelion, of the very small genus *Leontodon ;* the common calyx of which is quite peculiar and remarkable, being formed of 2 series of leaves, one of them erect and equal, the other row situated near the base of the former, and somewhat flaccidly reflected. The common receptacle, or plane of insertion for the florets, which constitute the compound ligulate flower, is naked of hairs, or chaffy processes, and merely exhibits slight impressions on which the seeds were seated, somewhat resembling the top of a honey-comb. The second essential character of the genus, after the calyx, is the nature of the pappus or down, the hairs of which, unlike some other genera, are simple, and the whole crown of them stipitate, or attached to a pedicle above the seed. With the rest of the plant you are already too well acquainted to require any further remarks.

The genus *Prenanthes* is by no means an uncommon one in our woods, and most of the species flower in autumn. Unlike the Dandelion, they are furnished with stems of from one, to four feet in height ; and leaves, either entire, or intricately lobed, and sinuated. The flowers, generally small, are in panicles or clusters, frequently nodding or inclining downwards, and of a yellowish white, or pale purple. The generic character is, to have the calyx surrounded at its base with leafy scales ; the florets few, (5 to 20) ; the receptacle naked ; the pappus simple, and nearly sessile, or without the intervening stipe of the Dandelion. That they are milky juiced plants is a circumstance of physical structure common to all plants with ligulate florets. The milky sap, with which some of the species of this genus particularly abounds, as in *P. alba*, and its polymorphous or protean varieties, has been occasionally employed with

considerable effect for the bite of the Rattlesnake, if we are to credit Mr. Pursh, the well known botanist.

In the genus *Lactuca*, or Lettuce, the calyx is imbricated and cylindrical; the receptacle naked; and the pappus or down simple, and stipitate. From this character *Sonchus*, or the Sow-thistle, only differs, in having the calyx wider at the base; and the simple threaded pappus sessile, or without the stipe. The aspect of the 2 genera is quite similar, and they both produce small yellow or blue flowers.

Throughout Massachusetts and other parts of New England, the meadows and way sides are, in the autumn, commonly enlivened with a yellow flowered humble plant, very similar to the Dandelion, but smaller, the *Apargia autumnalis*, distinguished from the other genera by having a simple imbricated calyx; a naked, punctate receptacle; and a plumose (or compound threaded) sessile, unequal pappus.

About the month of May and June may not unfrequently be observed a very small, but elegant orange yellow flowered annual, opening only to the morning sun, called by the celebrated Willdenow, *Krigia virginica.* It is smooth and glaucous, or pale green; with entire, or lyrate leaves; sending out 1-flowered scapes, like a diminutive Dandelion. The calyx consists of a simple row of leaves; the receptacle is naked; the pappus double; the exterior one 5 to 8-leaved, the interior (according to the size of the species) consists also of 5 to 8, or as many as 24 scabrous bristles in the much larger flowered perennial species *K. amplexicaulis* of the middle states.

Our next section is the FLOSCULOSÆ, *the florets of which are all tubular.*

The first genus which we shall examine in this section is the *Arctium*, or Burdock; a large weed, but too common in wastes and by way-sides, produc-

ing, at first, large, and somewhat downy heart-shaped leaves; and afterwards branching stems terminating in a profusion of purplish flowers, inclosed in a globular calyx, covered with scales imbricated or tiled over each other, and ending in hooked bristles, which readily adhere to the hair of most animals, and prove very troublesome. The receptacle is chaffy; and the pappus of a consistence betwixt bristles and chaff.

The Thistle (*Carduus*), as to its general appearance, is too well known to need description here; but its generic character is, to have a ventricose calyx, formed of many imbricated scales ending in spines. The receptacle is simply hairy. The pappus deciduous (or easily separable from the seed), and either hairy or plumose. From these the

Onopordon, or Cotton Thistle, now naturalized in wastes, in the northern states, differs principally, by its pitted receptacle, which resembles a honey-comb. The species, thus naturalized, is *O. acanthium*, which may be known by its broad, ovate-oblong, decurrent, sinuated, spiny leaves, woolly on either side.

The Artichoke (*Cynara*) differs chiefly from the Thistle in the structure of the calyx, the scales being filmy and ragged on the edges, but fleshy, and terminated by a channelled, emarginate, and pointed appendage. In this, and the 2 preceding genera, the great size of the florets affords plain examples of the structure of these compound flowers, but they differ from most others in the undivided stigma.

Related to the Thistle, through the medium of the very proximate genus *Serratula*, is that of *Vernonia*, peculiarly American. Most of the species, alike in habit, are tall, coarse, and common plants, growing in moist places, and by the banks of rivers, flowering in autumn, and extending from the western parts of

Massachusetts to the Gulf of Mexico, the number of species slowly increasing to the south and west, to the number, now, of about 6. The leaves in all are long, and mostly lanceolate, with their margins serrated, and the flowers, resembling those of minute purple thistles, form a considerable compounded corymb. The species are best distinguished by the calyx, which varying in size, is either ovate, or more rarely, hemispherical, formed of imbricated scales, either merely acute and closely laid over each other, or else ending, as in *V. noveboracensis*, in filiform points. These points are carried to an unusual length in a yet undescribed species of Arkansa territory, in which the flowers are large and hemispherical, and the calyx so appendaged and squarrose as to form, almost, a Medusa's head; in this, the leaves are likewise very long, and narrow. Besides the generic character derived from the calyx (which is that of *Serratula*), the stigma, as in the following genus, is bifid; but the most decided trait of *Vernonia* is in the existence of a *double* pappus, the exterior short and chaffy in some degree, and the interior capillary.

Liatris, allied to *Vernonia*, is one of the most elegant genera of the class, peculiar to the United States, and of which there are known 12 or 13 species. The genus is very naturally divisible into 2 sections; namely, those with round tuberous roots, and undivided or simple stems; and those with fibrous roots, and flowers in corymbs. Those of the first section, whose species extend the farthest north, are remarkable for the grass-like narrowness of their leaves, elegantly contrasted with the showy magnitude, and beautiful pink purple of their autumnal flowers. To this section belong those which have been esteemed for the bites of poisonous reptiles; and hence

some of their species are known by the imposing name of Rattlesnake's-master. In the second section, with corymbose flowers, the root-leaves are rather broad, and nerved, or veined in 3 or 5 prominent leading lines. The *L. odoratissima* of the Carolinas is quite remarkable for its long persisting, and powerful Vanilla odor, possessed by none of the other species; and this property is so obvious as to have long obtained for the species the name of 'Vanilla-plant.' The character of the genus is, to have an oblong or hemispherical imbricated calyx; a naked receptacle; the pappus (elegantly) plumose, persistent, (and commonly colored somewhat purple). The seed is also obconic, striated, and pubescent. The most northern species is the *L. scariosa*, having a large hemispherical calyx, composed of obovate, nearly smooth scales, with scariose (or chaffy) margins, and the lower ones spreading; the lower leaves are lanceolate, but, as is the manner of the genus, they diminish in size as they ascend the stem, until they become little more than narrow oblong scales.

Another very prevalent genus of the flosculous flowered kind is *Eupatorium*, known in Europe by the name of Hemp Agrimony; with us by several variable names, according to the species. They are generally conspicuous for size, grow in rich, moist grounds, and bear a profusion of small flowers, in large, flat-topped clusters. The genus is described as having an imbricate, oblong, loose calyx; a long, deeply-cleft, conspicuous style; the receptacle naked; the pappus scabrous; the seed angular, or with 5 striatures. In wet grounds, and near waters, in the autumn, throughout the United States, you will frequently meet with 4 tall species, or rather varieties, of this genus, with the broad lanceolate, and serrated leaves, verticillated, or growing by 3 to 5 at each

joint of the purple stem, and terminated above by numerous clusters of small, shining purplish flowers. These, all formerly included in the tall *E. verticillatum*, have leaves and flowers of a bitterish taste, arising from the dispersion of numerous minute, and superficial resinous, yellow glands or scales, and have been employed as useful tonics. The most remarkable, however, of these medicinal species is the American Thoroughwort, or *E. perfoliatum*, having pubescent, rugose (or wrinkled) leaves, growing so together at the base, as to appear but one, perforated by the stem. In this, the flowers are white. But the most beautiful species in existence, is the *E. cœlestinum*, growing wild by river banks, from the Potomac to the Mississippi. Its flowers, produced very late in autumn, are of a beautiful smalt or sky blue, with the leaves cordate-ovate, and toothed.

Scarcely distinct from Eupatorium is the *Mikania* of Willdenow; all the species of which, American, and some of them tropical, are twining-stemmed perennials, mostly with cordate, acuminated leaves; and copious, axillary corymbs of purplish flowers, so small, taken singly, as to have a calyx of only 4 to 6 leaves, with 4 to 6 flowers on a naked receptacle, and a hairy pappus.

SUPERFLUA.

In this order, characterized by producing 2 kinds of florets in the same common calyx, those in the ray styliferous only, and those in the disk tubular and perfect; there are likewise 2 sections, but much less obvious than those of the preceding order *Æqualis*. In the first the

* *Florets of the ray are obsolete.*

Such are the flowers of the Tansey (*Tanacetum*),

which bears an imbricated, hemispherical calyx, with pointed scales. The rays of the corolla indistinct, and trifid; the receptacle naked, and the pappus an indistinct, and mere margin.

In the *Conyza*, or Marsh Fleabane, so common in all our saline meadows, known by its strong and somewhat disagreeable odor, and its shining terminal clusters of purplish flowers, the calyx is imbricated, with the scales often chaffy and dry; the receptacle naked; and the marginal fertile florets 3-cleft. The pappus is simple and capillary.

Gnaphalium, or Flower Everlasting, also appertains to this ambiguous section, having an imbricated calyx, with the scales scariose (or chaffy), and mostly colored; the receptacle naked; the florets of the ray (so minute and imperfect as to appear) subulate (or awl-shaped); the fertile ones are entire; and the pappus scabrous, or not quite simple. One of the most remarkable species, in some respects, is the very early flowering *G. plantagineum*, which produces hoary, radical, ovate, 3-nerved, mucronated leaves, sending out procumbent infertile shoots, and many low, simple stems, with small flat clusters of whitish flowers, which are dioicous, or of 2 different sexes, on 2 different plants. The *G. margaritaceum*, or common Everlasting, is one of the most showy American species, producing very narrow, tomentose leaves; and corymbs of globose, silvery white, shining flowers, which, as in the rest of the genus, abounding in Europe, and at the Cape of Good Hope, in Africa, owe all their beauty to the fine color of the spreading, and dry scales or leaves of the calyx.

** *Florets of the ray ligulate.*

In all the plants of this section the flowers are provided with rays, as in the Daisy, resembling a ring of

marginal petals. These rays are flattened, or ligulate florets, furnished only with styles, and are commonly white, blue, or purple, while the perfect tubular florets of the disk are generally yellow.

We shall commence the examples of this section by one of the commonest weeds of North America, in flower throughout the autumn, in every sterile fallow field and neglected garden, spreading itself with such facility by its innumerable winged seeds, as to have now become also equally common throughout Europe and northern Asia, having, probably, completed in its migration the whole circle of the globe in which it had originated. To this inelegant and obscure flowered weed, long known as the Canadian Fleabane (*Erigeron canadense*), differing so materially from the true Erigerons, I some years ago gave the name of *Cænotus* (in allusion to the commonness of the plant), forming of it then only a subgenus, though it probably merits separation as a perfect genus, including about 3 species, formerly Erigerons. Having very many minute radial florets, they are closely allied to the preceding section of flowers with inconspicuous or anomalous rays. They have, also, an oblong calyx; and a simple pappus. The common species alluded to, is either annual or biennial, and of every size, from a few inches to 5 feet, according to the nature of the soil on which it grows. The stem is hairy or hispid, and paniculated; the leaves narrow, and lanceolate, the lower ones partly serrated; the rays are crowded, very short, and yellowish white, in common with the rest of the flower. There is also a second species, with all the leaves entire, in other respects very similar, but always small. A third very distinct species, is Michaux's *Erigeron divaricatum*, indigenous to the banks of the Ohio and Mississippi near their junction. This is a low grow-

15

ing, extremely branched, biennial plant, with entire, narrow, pubescent leaves.

The true *Erigerons* are Daisy-like looking plants of common occurrence, having an imbricated, nearly hemispherical calyx, with the florets of the ray very numerous, narrow, and rather long. The receptacle is naked; and the pappus double (when examined through a lens); the exterior minute; the interior hairy, and of few rays. One of our handsomest common vernal flowering species is the *E. bellidifolium*, in some places known by the name of Poor Robin's Plantain, and the leaves chewed as a substitute for Tobacco. It is of low growth, each stem producing only from 3 to 5 large, bluish, Daisy-like flowers, with the rays nearly twice as long as the hemispherical calyx; the radical leaves are obovate, hairy, and coarsely serrated; the stem leaves remote, clasping, and entire. The other species are taller, and produce many flowers, either white, or pale blue in the ray.

The genus *Aster*, or Starflower, of which the United States present more than 60 species, profusely decorating with their copious flowers our autumnal scenery, is nearly allied to *Erigeron;* but the rays are fewer, and somewhat broader, generally more than 10, never yellow, as in most of the *Inulas*, being either white, bluish, or purple. The calyx is imbricate, with the lower scales often spreading (showing their near relation to the minute leaves, which commonly clothe the flower branch). The receptacle is naked; and the pappus simple, and many-haired. The *Asters* are large plants, and grow in almost all situations where the soil is good, and often in the shade of bushes and trees.

So nearly related to *Aster* is the American species of Inula, which I have termed *Chrysopsis*, that several

of the former Asters, with corymbose flowers, form, in fact, a part of that division, though they have not the characteristic yellow flowers. In these the calyx is closely imbricated, and no part of it spreading; the receptacle naked; the pappus scabrous (or somewhat subdivided); and, in nearly all the native species of our subgenus, furnished with a short, exterior chaffy pappus.

The smallness of the flowers at once distinguish the *Solidago's*, or Golden-rods, from the *Inulas;* these have also small imbricated calyces, with the scales very generally connivent. The florets of the ray are only about 5, and yellow. The receptacle naked; and the pappus simple and scabrous. The genus is naturally divisible into 2 sections; in one of which the flowers are disposed in terminal, secund (or 1-sided) racemes; in the other, they form irregular, and smaller clusters.

One of our too common weeds in dry pastures, is the White-weed, or Ox-eye Daisy, of the genus *Chrysanthemum.* This plant has an hemispherical, imbricated calyx, the close scales of which have membranaceous margins. The receptacle is naked; and there is no pappus. Our only species wild, is the *C. leucanthemum*, which, for a great part of the year, continues to send up simple stems, clothed with amplexicaule, lanceolate, serrated leaves, more deeply cleft at the base, and terminating in large, Daisy-like, white rayed flowers. Of the same genus are those beautiful and numerous varieties of the *C. Indicum*, so commonly cultivated, and so grateful in appearance, blooming to the very approach of winter, when all other flowers have disappeared; but these, of so many fine colors, introduced from China, are always double, or rather monstrous, having the perfect discal florets all transformed into ligulate or radial ones, and pro-

duce no seed. In what, however, are called the quill-flowered varieties the florets are only partially slit open, the remaining part being narrow and tubular.

In *Achillea*, or Millfoil, the common species so well known for its compoundly and finely divided leaves, somewhat resembling Tansey, and producing corymbs of white flowers, the calyx is ovate, imbricate and unequal; the rays 5 to 10, are roundish, and short. The receptacle chaffy (or leafy), and the seeds without either pappus or border.

The curious American genus *Helenium*, of which one tall growing species (*H. autumnale*) is quite common in wet places, flowering from August to September, having decurrent, lanceolate, serrated leaves, and corymbose, showy yellow flowers, is characterized by having a simple, many-parted, spreading calyx. The rays 3-cleft; the receptacle naked, globose, bearing chaffy scales near its margin. The seed villous; and the pappus of 5-awned scales (or chaffy leaflets).

The African Marygold, or *Tagetes*, a Mexican genus, 2 of whose species we have in common cultivation, are curiously distinguished by having a tubular calyx of one piece, 5-toothed at its summit; and about 5 permanent florets to the ray. The receptacle is naked; and the seeds are crowned with about 5 unequal chaffy scales. The leaves are very finely subdivided, and the whole plant, at least the common kinds, gives out, on touching, a strong odor, similar to Rue.

Another very showy ornament to our flower gardens are the species of the genus *Zinnia*, also originally from Mexico, and chiefly annuals. They have a look of *Tagetes*, but have an imbricated, round scaled calyx; and 5, or more, remarkably persisting broad rays. The receptacle is chaffy; and the pappus consists of 2 awns. Besides those, now well known in

every garden, 3 or 4 remarkable and beautiful species, some of them perennial, not yet published, have been discovered near the Rocky Mountains. In one of these the flowers are yellow.

FRUSTRANEA.

This order likewise consists of radiated flowers resembling the last section of the preceding, and merely differ in the condition of the rays, which are neutral; mere ligulate florets, almost petals, without either style or stamens, though provided with the rudiments of the seed at their base.

The first and most obvious genus, with these conditions, is the *Helianthus*, or Sunflower, also, an exclusive American genus. The *H. annuus* becoming of such gigantic dimensions as to afford in its enormous flowers, not only, a good example of its order, but also of the characters of the class. The calyx is imbricate, somewhat squarrose and leafy. The receptacle chaffy, and flat. The pappus 2 caducous (or quickly shed) chaffy leaves.

In *Rudbeckia*, a genus also exclusively American, the leaves of the calyx are nearly equal, and commonly arranged in a double series. The receptacle is conic, and provided with chaff. The pappus a 4-toothed margin, or nearly indistinct. The common species, in gardens, and wild in the southern states, has purple flowers, and long pendulous rays, with the receptacular chaff colored and pungently rigid. In those with yellow flowers it is often blunt; one of these, the *R. laciniata*, is the giant of our swamps and wet places, having pinnately-divided, 3-lobed leaflets, and produces yellow flowers, somewhat resembling those of *Helianthus*.

But one of the most elegant genera in the United

States is that of *Coreopsis*, or Tick-seed Sunflower, which has a double calyx; each of many leaves, the exterior shorter and green, the interior equal, partly coriaceous, and coloured. The receptacle producing flat, chaffy scales. The seeds compressed, emarginate, and often bidentate. Some of the species are cultivated in gardens, and have yellow flowers. Most of them belong to the milder latitudes, but they are all peculiar to America. In the open swamps of New Jersey there is a low, narrow leaved species with rose colored flowers; but the most beautiful, yet known, is the *C. tinctoria*, an annual or biennial, originally from Arkansa territory, but now common in most gardens; its radical leaves are bipinnately divided, those of the stem pinnated in narrow segments; the flowers come out in May, and are of a fine orange yellow, with a brown centre. It gives a reddish yellow, indellible stain to cotton, and, as well as the *C. senifolia*, might be employed for dying.

The Blue Bottle of our gardens, originally from the corn-fields of Europe, belongs to a remarkable genus, of great extent in species called *Centaurea*, of which, as yet, but a single one, has been discovered in either continent of America. In all, the corollas or florets of the ray are funnel-form or tubular, longer than those of the disc, and irregular; the pappus is simple, and the receptacle bristly. The genus is naturally divisible into sections or subgenera, principally, from the nature of the calyx. In the Blue Bottle (*Centaurea Cyanus*) the scales of the calyx are without either armature or appendages; the leaves are linear and entire, but below often broader and divided. The flowers, though originally blue, in gardens, present varieties with white, brown, and particolored rays. But the largest flowered species of the genus, is, perhaps, the solitary one of the United States, now culti-

vated as an annual, being spontaneous, in alluvial situations, near the banks of Red River and of the Arkansa. This plant attains the height of 3 or 4 feet, is nearly quite smooth, with sessile, ovate, acute, rarely toothed leaves, the upper ones quite entire; the branches, few in number, are terminated each by a large flower of a pale pink color; the calyx is extremely curious, having all its imbricated scales terminated by moveable, chaffy, shining processes, pinnatifidly cleft into bristly ciliæ. The pappus is hairy, and of unequal length. The rays of *Centaurea*, often cleft with more than 5 divisions, appear to be double, infertile tubular florets, enlarged in size from the absence of all other organs. A transformation of this kind, though acting on uncombined florets, is familiar in the double, or rather monstrous flowers of the common Feverfew (*Crysanthemum Parthenium*), where the enlarged tubular florets of the disk are also deprived of the style and stamens.

NECESSARIA.

In this order the rays only are fertile, for the central or discal florets, though to all appearance perfect, are constantly sterile. These plants then are easily known by producing seed on the margin of the disk only.

The common Marygold (*Calendula officinalis*), in almost every garden, affords one of the few examples of this order which are known to exist. The calyx consists of many equal leaves; the receptacle is naked; the seeds are without pappus, and curved; those of the disk are imperfect and membranous. The flower is of an orange yellow, and frequently double or monstrous, having all the florets ligulate.

In the southern, middle, and western states, the savannas, prairies, and mountain meadows, present us

with a gigantic race of plants, the *Silphiums*, somewhat resembling Sunflowers, but whose generic character is too remarkable to allow them to be mistaken for any thing else. They have a peculiar calyx, with spreading or squarrose segments, which are broad, and end in short leafy appendages. The receptacle is provided with chaffy leaflets. The seed is flat, obcordate (or inversely heart-shaped), emarginate, and bidentate (or 2-toothed). The flowers are always yellow, and the rays have remarkably long and obvious styles. The infertile discal florets often fall out before the disappearance of the rays.

The *Polymnias*, of this order, as well as the preceding, an exclusive American genus, are also gigantic yellow flowered plants, growing in rich, moist, shady, and mostly rocky woods. In these the calyx is double; the exterior being 4 or 5 leaved; the interior 10-leaved; the leaflets concave by the swelling of the large seed; the receptacle chaffy; the seed without pappus.

In salt marshes is frequently to be found a shrubby plant with opposite, ovate, lanceolate, deeply serrated, and somewhat scabrous leaves; having depressed globular flowers of a greenish color, and without beauty, which will be found to agree with the genus *Iva*, having a 5-leaved, or 5-parted calyx. The florets of the ray 5 (and small); the receptacle hairy; and the seed obovate, and naked.

SEGREGATA.

In this order there are 2 sets of calyces; the outer, or common involucrum, for such by analogy it really is in the whole class; and here an inner, or included calyx also of the same character, containing one or more florets, and thus producing, as it were, a doubly compound flower.

Of native examples we have only the genus *Elephantopus*, or Elephants'-Foot, a low growing, hairy leaved perennial, of the middle and southern states, in dry soils, with a few, slender, divaricate, and almost naked branches terminating in 3-sided, 3-leaved calyces, containing other partial ones, with 4, 5-cleft, perfect ligulate purple florets in each. In these the receptacle is naked; and the pappus bristly.

In gardens may sometimes be found the Globe Thistle, or *Echinops*, which has only one perfect tubular (blue) floret to each partial calyx; the seeds have also an obscure pappus; and the receptacle is bristly. The leaves of the Globe Thistle (*E. sphærocephalus*) are sinuous and pubescent, the divisions ending in spines; the flowers are in globular heads.

CHAPTER XXVI.

OF THE CLASS GYNANDRIA.

THE ostensible character of this class is to have the stamens, one or more, inserted upon, or attached to the style: but from the great dissimilarity of these organs to those of all the other classes, except the family of the ASCLEPIADEÆ, their total absence might perhaps he imagined by the superficial observer, and to render the subject more intelligible, it will be proper, first to give a general view of the natural family of the ORCHIDEÆ, which forms the principal part of the present class. Most of the genera and species are of perennial duration, and grow in moist and shady places where vegetable earth abounds; indeed, some of them, particularly in tropical climates, as the tribe of *Epidendrons* exist only as parasites, attached to the bark of trees by their fleshy fibred roots. The roots of many are tuberous, and these pass by insensible grades

to the character of thick and branching fibres, all of which are annually and laterally renewed, so that in many of the tubers, as those of *Aplectrum* and *Epidendrum*, the annually rejected, inert, and withering tubers form concatenated links of several individuals, possessing different degrees of vitality, and power of reproducing plants. Nearly all the genera, however, except those with fibrous or clasping roots, appear to be of slow and difficult propagation, and are, therefore, but seldom successfully cultivated ; nor will many of them exist at all except in the shade of the forest, and amidst recent vegetable soil.—The leaves of the whole tribe are invariably entire, not even so much as serrated on the edges, and commonly of an oblong or elliptic form, and wholly or partially, as in grasses, embracing the stem by their base. The stems or scapes are simple or undivided ; and the flowers arranged in spikes or racemes. In all, the corolla, for there is no calyx, is referrible to a division into 6 parts, as in the Lilies ; but these are of different forms, and in several combinations ; 5 of these parts are always external, but frequently in 2 ranges, as in *Orchis*, where the 3 external resemble a calyx, and there are then 2 internal divisions like petals, conniving together beneath one of the external segments, so as to resemble a hood or helmet. The 6th segment or lip, for they always appear ringent flowers, possesses the most varied forms, being a perfect vegetable Proteus. It is collocated opposite to the style, which is often petaloid, and seems then to form an upper lip in accordance with the lower, or true petal. In *Orchis* this 6th petal or lip is often trifid, more rarely simple, and sometimes divided into fringe or hairs ; its base terminates in a sac or elongated nectariferous cavity, called the spur. In the *Cypripedium* or Ladies'-slipper, which has mostly 2 of its petals ingrafted so as to appear but one, with

a notch at its extremity, this sac or cavity is very large, more resembling a bladder than a slipper, and all the rest of the lip is merged in this part of the organ, of which, however, there are still vestiges, and a sort of spur at the base of the sac, in *Cypripedium arietinum,* and even 5 perfect petals. In the genus *Ophrys*, as now limited, altogether exotic, the lip puts on the most fantastic forms and colors, so as, with the rest of the flower, to resemble different insects, such as the Fly, the Bee, the Wasp, and the Spider, and in another the rude form of a man suspended by the head. The style in this family is never central, but so inclined to one side as to resemble an upper lip to the corolla. This organ in *Orchis* presents 2 lateral sacs, in each of which are included a stipitate, clavate (or club-shaped) mass of pollen agglutinated together. In many other genera the masses of pollen (2, 4, or 8) are inserted into the under side of an articulated moveable lid, seated near, or upon the summit of the style. The fruit is universally a 3-sided capsule, with 3 valves, but only one cell, and filled with very many minute seeds, of which extremely few are ever fertile. The only example with which I am acquainted, where these seeds are necessarily perfect, is in the very curious *Chiloglottis* of New-Holland, which, contrary to the whole order besides, is only of an annual duration. The tropical genera of the natural section Epidendra, presenting a labyrinth of generic characters, or very small groups, are remarkable for the beauty and vivid coloring of their flowers, and the fantastic forms of the ever varying 6th petal, or lip. From this tribe we derive the Vanilla of commerce, which is the pod or capsule of the *Epidendron Vanilla*. Salep is obtained from the roots of some of the species of *Orchis;* but, in general, the terrestrial plants of the Orchideæ are of such a rare and scattered occurrence, and con-

nected with such uncommon and mutable circumstances of soil and situation, as to promise little to man, but the rational amusement of admiring and observing their very singular and uncommon structure.

We have already had occasion to observe a natural tendency to abortion of parts and organs in the tribe of ringent or irregular flowers; we have remarked, that, in the LABIATÆ, instead of 5 stamens, existing in symmetry with the perianth of quinary divisions, 4 are generally found; and in several genera, as *Monarda, Cunila, Salvia*, and *Collinsonia*, only 2 perfect stamens, in common; but in the Sage 2 other imperfect anthers, and in one of the Collinsonias no less than 4 perfect anthers, constantly. The 5th stamen, of which the rudiment is often present, is likewise suppressed, in the flowers of the 2d order (ANGIOSPERMIA) of DIDYNAMIA, or irregular flowers. There is, also, every reason to believe, that in this monocotyledonous tribe, the ORCHIDEÆ, whose flowers are always irregular, there exists an hereditary abortion of organs; and this is rendered still more probable from the remarkably eccentric, or even lateral position of the style, and the absence of filaments; the moveable disk, on which the pollen is seated, being all the special support which the anthers, or their substitute, the polinia (or masses of pollen), ever present. The 6 petals, and 3-sided capsule, would lead us to expect, as in the Lily, a ternary number in the stamens and stigma, if complete; but from the restraint and abortion induced or indicated by the irregularity of the corolla, and the unconcentric position of the central organs, we never find more than an indication of 2 lobes to the stigma. In *Orchis*, and some other related genera, there are only 2 pollinia or equal to one anther; but in *Malaxis, Corrallorhiza* (Coral-root), and some others, 4 pollinia, or 2 anthers; and in *Bletia*, 8 pollinia,

or 4 anthers; thus making as near an approach to 6, as the *Convallaria bifolia*, in which all the parts of the flower are diminished to 4, though inseparable, in other respects, from the rest of the *Convallaria's* in which the parts are by 6's. Thus amidst aberrations so obscure, and variations so intricate from the original plan or type of vegetable families, still the lights of analogy, by furnishing, as it were, links of connexion, lead, at length, to a real affinity of objects; and we are satisfied, that though the ORCHIDEÆ form a most distinct and natural family among themselves, they have still an unalienable relation with the great liliaceous tribe of the same monocotyledonous class.

The artificial orders of our class Gynandria, which includes a few other genera besides the ORCHIDEÆ, are again founded on the number of the stamens, and in *Monandria* we find, first, the genus

Orchis, of which our mossy swamps and very shady woods afford no inconsiderable variety, flowering about midsummer and the commencement of autumn. The corolla is ringent, the upper petals forming a vault or helmet. The lip is dilated (or widened), having a spur beneath. The pollinia (or masses of pollen, as there are no true anthers) are 2 in number, and will be found concealed within the lateral sacs, or hooded hollows of the stigma. The earliest flowering species, not uncommon in the middle states, is the *O. spectabilis*, which has an obovate, undivided, crenate, blunt lip (generally purple or rather lilac), and finely contrasted with the other straight and white petals. The spur is clavate (or club-shaped), and shorter than the germ; the bractes are longer than the flower; and the stem leafless; 2 or 3 large leaves, however, are situated at the base of the stem. The *O. ciliaris* of our swamps flowering in August, has an oblong, lanceolate, pinnately ciliate (or fringed) lip, twice as long as the

16

petals; and, as well as the whole raceme of flowers, is of a bright orange inclining to white. This species is, again, scarcely to be distinguished from the *O. blephariglottis*, excepting by the snow white elegant flowers, and shorter lip of the latter. The *O. psycodes* has greenish flowers with a 3-parted lip, having its segments divided like hairs, and below a long filiform, clavate, ascending spur. Another, rather common species, in the northern states, flowering in July, is the *O. fimbriata*, bearing racemes of fine purple flowers, and having a 3-parted lip, scarcely longer than the petals, with the segments cuneiform (or wedge-shaped), and ciliately fringed; the lateral petals are also a little torn; the spur filiform, clavate, and longer than the germ. There are 2 or 3 other species very similar to this, of which the *O. grandiflora* is the most beautiful for the superior size, and often, fragrance of its flowers. All these species, except the first, are by some referred to *Habenaria*, but do not appear possessed of any very obvious distinguishing trait, and are not to be known apart by aspect or habit.

Of the genus *Neottia*, or its subgenus *Spiranthes* of Richard, we have several species, common both in dry sandy woods, and in wet meadows. These come out late in the season, have all white flowers inclined to one side, and form a twisted or spiral wreath like a stair-case of the same construction. The genus is characterized as follows. The corolla is ringent, with the 2 lower petals passing beneath the lip, which is beardless; the interior petals are connivent. The column (or style) apterous (or wingless); the pollen farinaceous. The leaves of the species vary a little in form, and the stems are nearly naked. In the following genera the pollinia are inserted in a lid at the summit of the stigma.

One of our most common little plants, in swamps

and wet meadows which have never been plowed, is the *Pogonia* (formerly *Arethusa*) *ophioglossoides*. It has a small fibrous root, the scape furnished with one oval leaf, and a leaf-like bracte almost immediately under the flower, which is rose color, or pale purple. Its character is to have 5 distinct petals without glands, a sessile lip, hooded (or drawn up at the sides), and internally crested (or fringed); the pollen farinaceous.

About the month of June, in the same mossy swamps with the preceding, may not unfrequently be found a still more curious and elegant purple flowered plant of the Orchideæ, a true *Arethusa*, the species *A. bulbosa*. The whole plant is scarcely a span high; its root is a small round tuber sending up a spathe, sheathed by an abortive leaf, and terminated mostly by a single large flower, though sometimes by 2 somewhat remote from each other; after a time, a linear radical leaf is often sent up. The flower has a very marked character of ringency, and consists of 5 petals, connate, (or growing together) at the base. The lip beneath growing to the column (or styles), cucullate (or hooded) above, and crested internally.

But one of the most elegant of all our swamp plants of this tribe is the *Calopogon* of Brown, *Cymbidium* of Willdenow, which flowers about July, and is common throughout the United States. The petals are 5, distinct; the lip behind (or inverted), unguiculate (or narrower below); the lamina conspicuously bearded. The column is free (or unconnected), and the pollen angular. Almost the only species is the *C. pulchellus*, which has a tuberous small root, sword-shaped, almost plaited, radical leaves, and a scape with several large purple flowers.

Another genus, of rather frequent occurrence in dry woods, near the roots of trees, is the *Malaxis*,

particularly the *M. liliifolia* in the middle states, flowering in June. The character is to have the 5 petals narrower than the lip, and spreading or deflected. The lip flattened, undivided, sessile, often exterior. The pollinia (or masses of pollen) 4, parallel with each other, applied to the stigma by their extremities. In *M. liliifolia*, the plants sometimes grow in clusters, having bulbous roots, from each of which arise 2 elliptic leaves, and a triangular scape of many flowers, with the interior petals, filiform and reflected; the lip brownish, concave, obovate, and acute at the point. A second, and somewhat similar species, with a narrower greenish lip sometimes occurs. This is the *M. Lœselii*, indigenous also to Europe, and found farther north than the preceding. A very dissimilar species is the *M. ophioglossoides*, which bears only a single, embracing ovate leaf, and a crowded raceme of minute greenish flowers. In this, of which I formed the sub-genus *Mycrostylis*, the lip is sessile, concave, and erect, with the summit truncated and bidentate (or 2 toothed); the column is minute. There are also 2 imperfect anthers, and three pollinia. It is in fact a very distinct genus.

The genus *Corallorhiza*, or Coral-root, from its branching, thick, fleshy coralloidal root destitute of fibres, is remarkable as being without leaves, and producing racemes of dusky brownish flowers, with the following character—The petals equal and connivent; the lip mostly produced or gibbous at the base; the column free; the pollinia 4, oblique, (or not parallel).

From the preceding genus, so different in habit, I ventured to separate the *Cymbidium hiemale* of Willdenow, under the name of *Aplectrum*, having no spur or gibbosity at the base of the lip. This curious plant is sometimes known by the name of Adam and Eve, from the small chain of bulbs which constitute its

roots, 2, 3, or more of them being horizontally connected. From each of these arises, in its germinating period, a single ovate and striated leaf, which remains green through the winter, and hence the specific name of *hiemale*. About May this leaf is succeeded by a scape and raceme of brownish flowers, with a 3-cleft, unspotted lip. The character is to have the petals equal and connivent; the lip unguiculate, and without any cavity or gibbosity at its base; the anther situated below the summit of the column; the polinia 4, oblique, and lenticular.

In DIANDRIA you find the genus *Cypripedium* or Lady's-slipper, also of the natural family of the ORCHIDEÆ, and not easily confounded with any thing else, after noticing its remarkable large, ventricose, inflated, saccate or almost bladder-like lip. Most of the species have also only 4 petals; and the under one bifid, (indicating that it is formed of 2, which are ingrafted together nearly to their points). The column terminates in a petaloid lobe, which varies in form in each of the species. They occur commonly in rich, and somewhat shady woods, and flower from May to June. They have copiously fibrous roots, and with the exception of the *C. acaule*, leafy, simple stems, more or less pubescent. The leaves are broad, sessile, and somewhat plaited or ribbed; the flowers, about 1 to 3 on a stem, are yellow, red, or in part white. In Europe there is but one species. In India and in the kingdom of Nepal there are several very curious species, some of them with evergreen leaves. In the United States there are 6 species.

In the order HEXANDRIA of this class, you meet with the genus *Aristolochia* or Birthwort. In these there is no calyx; and the corolla of one ligulate petal with a ventricose base. The capsule is 6-celled, many seeded, and inferior.—One of the most

16*

important species, in a medicinal view, is the *A. serpentaria*, or Virginia Snakeroot, the fibrous root of which is highly aromatic; it has a short erect zigzag stem, set with cordate, oblong, acuminated leaves; the peduncles radical, and the lip of the corolla lanceolate.—The *A. Sipho*, or Dutchman's pipe, from the singular form of the corolla, produces woody and profusely spreading twining stems, with large heart-shaped, acute, smooth leaves; the peduncles 1-flowered, and with an ovate bracte; the corolla ascending (brown), and the border slightly 3-lobed, and equal.

In Dodecandria is now arranged the genus *Asarum*, allied to the preceding. Our common species, so similar to that of Europe (*A. canadense*), known by the name of Indian-Ginger, has creeping, aromatic, thick roots of nearly the same taste and smell with the Snakeroot, from which arise clusters of very short stems, each with two leaves; in the centre of them comes out an overshadowed brown flower, externally hairy consisting merely of a campanulate, 3 or 4-cleft calyx, without any corolla. The anthers have the peculiarity of being adnate to about the middle of the filaments. The capsule is inferior, 6-celled, and crowned with the calyx.

CHAPTER XXVII.

OF THE CLASS MONŒCIA.

In this, and the following class, there exist two kinds of flowers necessary to the perfection of the species. The infertile ones are, of course, those which produce stamens only, and disappear without any succeeding fruit. We have, already, probably met with occasional species in some of the preceding classes whose flowers are in this condition. Such are all the

native species of *Vitis*, or Grape-vines, some of the plants producing staminiferous flowers only, with the rudiments of a pistillum which is never perfected; other plants produce both stamens and fruitful germs, though these stamens are probably imperfect. The proper situation then of this genus would have been in the next classs DIŒCIA, but this circumstance, probably unknown to Linnæus at first, induced him, naturally enough, to retain them, notwithstanding, in the same genus with the Vine of Europe, whose flowers are always perfect (or each of them provided with all the organs necessary to the perfection of the fruit). Many other genera, also, include species which are Monœcious or Diœcious, but are still retained in the same class of perfect flowers to which the majority are referrible. In our present class, the two kinds of flowers constituting the same species are situated on different parts of the same plant; and to this allusion is made in the term *Monœcia*, which signifies one habitation. Whether this circumstance of the comparative fertility of flowers alone ought to be of any primary importance in a system of classification may well be questioned. There are, however, in this and the following classes, a considerable number of plants which differ not merely in this respect, but likewise in the nature and form of the perianth; as, for example, in the nut tribe (CORYLACEÆ), where the staminiferous or male flowers, in catkins or aments, bear little or no resemblance to the pistilliferous or female flowers, which produce the nuts or fruit. To such plants this distinction of classification would be well applied; and all the rest, with flowers similar in themselves, though perfect or imperfect, might be referred, properly enough, to any of the other classes by the number and disposition of their stamens. That such plants as those of the CORYLACEÆ ought to be retained in a particular class, like

that of the present and following, is likewise obvious from the variable number of their stamina, which would render their arrangement elsewhere not only unnatural, but perplexing, and almost impossible, and the genera instead of being, as they now are, brought together, would then be dispersed, and nearly lost in the rest of the different classes of the system.

The class being founded on the circumstance of fertile and infertile flowers on the same plant; the orders are conveniently taken from the other classes, according to the number and accidents of the stamens.

In the order MONANDRIA, then, we now find the somewhat puzzling genus *Euphorbia*, or Spurge, forming the type of the natural order EUPHORBIACEÆ, formerly arranged in *Dodecandria*, and then considered as a simple, in place of a compound flower. They all contain an acrid milky juice, that of some of the succulent species when inspissated forming the gum *Euphorbium* of commerce. They are chiefly found in Europe and Africa. Those of the latter continent, vegetating in arid sandy grounds and deserts, have, like the *Cactuses* of America, growing in like situations, succulent, columnar stems, mostly destitute of leaves, but often armed with clustered and scattered spines. The general composition of their flowers and generic character is as follows—They present a ventricose, or cup-shaped involucrum, resembling a calyx, of which the alternate segments are petaloid. The sterile flowers, 12 or more, are generally simple; each of them consisting of a mere anther with its filament, articulated to a pedicel (and proving themselves, however simple, still to be so many distinct flowers by coming to maturity at several successive periods). The calyx and corolla is very rarely present. The fertile flower is solitary, central, and stipitate (or pedicellate), without either calyx or corolla. The styles are 3, each

of them bifid (or cleft); and the capsule 3-lobed, and 3-seeded; the seeds at length bursting out with an elastic spring, by means of a peculiar integument or arillus with which they are at first surrounded. One of the most elegant species peculiar to the United States, is the *E. corollata*, a perennial, with subdivided umbels of conspicuous white flowers, and narrowish, oblong, obtuse leaves. This plant is not uncommon in the sandy fields of the middle states, and is in flower about June and July. The *E. ipecacuanha*, so abundant in the sandy fields of New Jersey, has been employed in medicine as a substitute for the drug indicated by its specific appellation. Its roots are extremely long, and rather thick; from which arise clusters of very low stems, clothed with reddish green, smooth, opposite, obovate, or narrow lanceolate, and very different looking leaves. The peduncles are few, axillary and terminal, 1-flowered, and rather long. It is in flower about May and June. The most elegant species in the United States is the *E. variegata* of Missouri and Arkansa territory, an annual now cultivated in the gardens, flowering late in autumn, and remarkable for its abundant variegated floral leaves.

In the order Triandria is the genus *Typha*, or Reed-Mace, referred to the natural family of the Aroideæ. The common species, *T. latifolia*, is a tall, reed-like plant, growing on the edges of ponds, with long, almost semicylindric leaves and stems, terminating in long, brown, and dense cylindric spikes of inconspicuous flowers; the uppermost, distinctly separated from the rest, are *sterile*, and without any kind of perianth. The 3 stamens in each of these minute floscules, arise from a chaffy or hairy receptacle, united below into a single filament or stipe. The *fertile flowers*, below the sterile, are also without

perianth; the pericarp (or seed) is pedicellated, and surrounded with a hairy pappus at the base. This plant is found in almost every climate, and in nearly every quarter of the globe.

The genus *Carex*, or Sedge-grass, of which there are not less than 90 species in this country, and a still greater number in Europe, belongs to the family of the CYPEROIDEÆ, and, as its common name implies, is nearly related to the grasses, for which they are commonly taken by ordinary observers. They grow in woods and marshy meadows, are perennial, often growing in tufts, have leaves like grass, but keeled, or sharply angled beneath in the centre, produce culms (or stems) almost universally triangular, and solid within.—The flowers, sometimes diœcious, as well as monœcious, are disposed in dense imbricated spikes or aments. The glume is 1-flowered; the corolla ventricose, 1-valved, persistent, often 2-toothed at the summit, and including the *caryopsis* (or seed). The staminiferous flowers have each but a single scale, or more properly bracte.

The *Mays*, or Indian Corn (*Zea Mays*), belongs to the family of the grasses, and affords a very intelligible example of Monœcia. The flowering top or panicle consists, as we all well know, of flowers which never produce corn. These are merely staminiferous glumes, each one including 2 flowers, which, as well as their common calyx, are awnless. The fertile flowers form a dense spike, inclosed in a husk or complicated sheath of bractes. The glume both of calyx and corolla is 2-valved and indistinct. The styles, one to each grain, are filiform and very long; the whole in each ear being exserted from its sheath, forms a silky tuft.

In TETRANDRIA is arranged the Alder (*Alnus*) of the order of the Willows (SALICINÆ); its sterile flowers

are collected into aments or catkins, made up of 3-flowered, wedge-shaped, and truncated receptacles or scales. The calyx is the 3-lobed scales of the ament. The corolla is 4-parted. In the *fertile flower*, the scales of the ament are 2-flowered, and partly trifid. There is no corolla. The seed is compressed and without winged margins. The *A. serrulata*, with roundish blunt leaves, and never rising above the magnitude of a shrub, is one of our most common plants on the borders of small water-courses.

The Mulberry tree (*Morus*) has its flowers in catkins. The *sterile* ones have a 4-parted calyx, and no corolla. The *fertile flowers* have also a 4-leaved calyx, which becomes a berry, and is equally devoid of corolla. There are 2 styles, and but one seed. To the same genus, though perhaps not very correctly, was referred the Fustick tree of commerce, or *M. tinctoria* of the West Indies. This species has oblong ovate leaves, and axillary thorns; the berry is also spherical, and very sweet to the taste. The genus belongs to the URTICEÆ, or natural family of the Nettle. Nearly related to this genus and very similar in habit or general aspect, is the *Broussonetia*, or Paper Mulberry, from the bark of which is prepared the linen worn by the inhabitants of the Friendly Islands, in the Pacific.

On the banks of Red River, and in other parts of the Arkansa territory, is found a considerable tree related to the Fustick, with heavy yellow wood, entirely similar. It also produces ovate, acute, entire, smooth leaves; has axillary thorns, and sterile flowers, with 4-leaved calyces, almost similar to the Mulberry; but the fertile flowers have but a single style; and the succulent calyces coalesce, or ingraft together so as to form but a single, spherical, juicy berry, like a large orange; but not, as far as is yet known, eata-

ble. To this peculiar genus, known as the Bow-wood and Osage Orange, I gave some years ago the name of *Maclura*. The junction of the germs into a single, large berry, brings this genus in character very near to the *Artocarpus*, or Bread Fruit.

In the order PENTANDRIA comes the *Amaranthus*, or Princes' Feather, forming the type of the natural group AMARANTHACEÆ. In both the fertile and sterile flower, the calyx is 3 to 5 leaved, and there is no corolla; the stamina are 3 to 6; there are 3 styles, and a 1-celled, 1-seeded capsule, opening transversely all round. They are, I believe, all annuals, and several of them cultivated. One of the most remarkable is the *A. tricolor*, whose leaves are blotched green, yellow, red, and sometimes brown.

In HEXANDRIA comes the *Zizania*, or Wild Rice, a tall aquatic grass, common on the margins of large ponds, lakes, and rivers of still water.—The *sterile flower* has no calyx, but a 2-valved and partly awned corolla; the *fertile flower* is also without calyx; the corolla of 2 valves, hooded and awned; the style 2-parted, and the cylindric seed, like common Rice, is invested by the corolla. The leaves in *Z. aquatica*, are rather broad, and like other grass in appearance; the flowers are in a large pyramidal pancicle, the fertile ones uppermost, at length approximating to the rachis, so as to form a kind of spike. The aborigines of the north-western territories, and particularly those of Lake Michigan, were in the habit of collecting large quantities of this rice for food, and it is very palatable, and swells when boiled as much as genuine rice.

In the artifical order POLYANDRIA you will find the genus *Sagittaria*, or Arrow-head, of the natural group ALISMACEÆ. The common species, as well as all the others, is aquatic, growing in muddy still waters.

It derives its name from the leaves, which are of the form of the Arrow-head. The flowers are white, have greatly the appearance of a *Ranunculus*, being produced on scapes, and grow always by 3's. In both kinds of flowers the calyx is 3-leaved, and the corolla of 3 petals. The stamina are numerous, but said to be definite, or constant to a certain number. In the *fertile flowers* the germs are numerous; the pericarps (or apparent seeds) are aggregated, 1-seeded, and do not spontaneously open. There are in the United States 9 or 10 distinct species, and some of them with leaves destitute of the arrow-shape; yet many have an occasional tendency to put on this form, when their usual leaves are different.

The genus of the Oak, or *Quercus*, is arranged here, and takes its place in the natural order of the Corylaceæ.—The sterile flowers are arranged in a loose ament or catkin, and have a calyx, which is mostly 5-cleft, but no corolla; the stamina are from 5 to 10; the fertile flower consists of a cup-shaped scaly involucrum; the calyx is incorporated with the germ, and 6-lobed; the germ 3-celled, with 2 of the cells abortive; the style single, but with 3 to 5 stigmas; the nut (or acorn) coriaceous, 1-celled, and 1-seeded, surrounded at the base by the enlarged cup-shaped involucrum. In the United States there are about 30 species, some of them evergreens, but the most part deciduous leaved; some of them have annual and others biennial fructification, or have the acorns produced in one or two different seasons. The cork is the spongy bark of the *Q. suber;* and from the *Q. coccifera* is obtained those excrescences which afford the galls of commerce. The *Quercitron*, so important and common a yellow dye, is produced by the bark of our *Q. tinctoria*, often improperly called Black Oak. It is remarkable that in all the oaks known,

there should be such a constant abortion of 2 thirds of the germs, that no acorn is ever detected containing more than a single seed.

The Hazlenut (*Corylus*), the type of the order Corylaceæ, so common a shrub in most of our bushy woods, has its *sterile flowers* in a cylindric ament (appearing long before the leaves), with the scales 3-cleft. There is no perianth. The stamina are about 8, with 1-celled anthers. In the *fertile flower* the calyx is obsolete (or scarcely discernible); the germs several; the stigmas 2; the nut ovate, and surrounded with the enlarged coriaceous and scaly involucrum.

In the Chesnut (*Castanea*), also of the natural order Corylaceæ, the *sterile flowers* are disposed in a long and naked, somewhat cylindric ament (or spike); each of them has a 1-leaved, 6-cleft calyx, and 10 to 12 stamens. The *fertile flowers* grow by 3's; the involucrum 4-lobed, and thickly muricated with bristly prickles; the calyx 5 to 6-lobed; the styles 6; the nut mostly 1-seeded, and invested with the enlarged involucrum. Of this genus there is a dwarf species (*C. pumila*) common in all the southern states and known by the name of *Chinquepin* with the leaves tomentose and hoary beneath.

The Walnut (*Juglans*) has the *sterile flowers* in an imbricated ament, and the scales mostly 5-parted; the calyx about 5-parted. The stamina vary in number, according to individuals and species, from 12 to 30. The *fertile flower* has a 4-cleft, superior calyx; a 4-parted corolla; 1 or 2 styles; a partly spongy drupe; the nut rugose, and irregularly furrowed. Of this genus there are about 4 species, and 2 of them peculiar to the United States. The *J. nigra* is one of the largest and most valuable of the American forest trees, and extends from the western parts of Massachusetts to Florida. The *J. cinerea*, or Butternut,

extends still further north, and has an oblong, acuminated nut deeply and irregularly sculptured. The bark of this species is also sometimes employed as a cathartic medicine. The kernels of both species are eatable, and not unpleasant.

From the genus *Juglans* I ventured to separate the Hickory, or White Walnut, by the name of *Carya*, and they both appertain to the natural family of the Corylaceæ.—The generic character is, to have the *sterile flowers* in an imbricated (trifid) ament, with the scales 3-parted; no calyx or corolla; the stamina 4 to 6. The *fertile flowers* have a 4-cleft, superior calyx; no corolla; no styles; but a partly discoid, 4-lobed stigma; the pericarp 4-valved; the nut partly quadrangular, and even on the surface. Of this well known genus there are about 8 species, with the general habits of the Walnut, but the wood tough and white, and the nuts of several of the species are bitter and inedible.

The genus *Platanus* (Plane or Button-wood) has its flowers in globose aments. The sterile ones without calyx; and with a very minute corolla. The anthers are adnate to the filaments from the base. In the *fertile flowers* the calyx is many-parted; there is no corolla; are curved stigma; the capsule somewhat club-shaped, 1-seeded, and mucronate, or pointed with the persistent style, having its base surrounded with a hairy pappus. The *P. occidentalis* is one of the largest and most majestic of the American forest-trees, growing generally by the banks of rivers, distinguishable at a distance by its white and blotched bark, pendent, globular aments, and angularly lobed leaves. The Asiatic Plane (*P. orientalis*) not very dissimilar from the preceding, having palmated leaves, was cultivated in Greece for its agreeable shade, often near temples and resorts of learning; and was early introduced

to Rome, where it became the favorite tree of the Roman villas.

The *Arum*, or Wake-robin, is the type of the natural order Aroideæ. It produces a 1-leaved, cucullate (or hooded) spathe. There is neither calyx nor corolla. The spadix (or columnar receptacle) is naked above, bearing sessile anthers below the middle, and the germs at the base. The berry (of which there are many on the same spadix) is commonly scarlet, 1-celled, and many-seeded. One of our most common and elegant species is the *A. triphyllum*, or Indian Turnip, with a round, tuberous, hot, and acrid root. From each of these arise 2 ternated leaves ; and from between them an ovate, acuminated spathe, with a flat and bent summit, striped like a zebra with greenish and brown bands. This species is also diœcious, one spathe or plant producing fertile, and the other infertile flowers.

In the order Monadelphia will be found the genus *Pinus* (the Pine or Fir tree) the type of the natural order Coniferæ. These are all resiniferous evergreens, most abundant in mild and cold climates, and here very frequent in sandy sterile soil. Their importance for timber, resin, turpentine, and pitch are well known. The kernels even of the Stone Pine (*Pinus Pinea*), as large almost as almonds, are eaten as a desert in Italy and the South of France.—The *sterile flowers* are in aments, of which the scales are peltate (or target-shaped) ; there is neither calyx nor corolla ; but 2, sessile, 1-celled anthers to each scale. The *fertile flowers* are collected into an ovate or conical strobile (or cone) ; with the scales closely imbricated, and 2-flowered ; no corolla ; the pericarp a winged nut covered by the scales of the cone. The genus presents 3 natural sections, or subgenera. The first is *Abies*, or the Fir tree, properly so called, in which the

leaves are solitary, and distinct at the base. Our commonest species is *A. canadensis*, called the Hemlock or Spruce tree, which has the leaves nearly in two rows, flat and denticulate; the cones ovate, terminal, and scarcely longer than the leaves. The *A. balsamea*, or Balsam Fir, has, also, flat, emarginate, or entire leaves, glaucous (or bluish green) beneath, arranged in several rows, recurvedly spreading; the cones large, purplish, cylindric, and erect. This very ornamental tree, so common in the northern states, extends by the Alleghany mountains as far as North Carolina, and is also found in the Rocky mountains towards the sources of the Missouri. It is scarcely distinct from the *A. picea* of Europe, and is very nearly related to the *P. speciosa* of the Hymalaya mountains, near the sources of the Ganges. The Canada Balsam is obtained from resinous blisters, which are pierced, and occupy the trunk of the tree. The leaves are remarkable for their persistence, adhering to the branches for several years.

In the true Pines (*Pinus*) the leaves narrow, long, and needle-formed, occur from 2 to 5 in a short cylindrical sheath; but in most of them the primordial leaves are solitary, and without sheathes, as in *Abies*. The clustered leaves of this section may then perhaps be considered, as they are in *Larix* or the Larch, minute branchlets, each, at first, enveloped like the larger buds with imbricated appropriate scales. All the species germinate with more than 2 seed-leaves, (from 3 to 8), a peculiarity unknown in any other family of plants. The species nearest related to the preceding section is the *Pinus strobus* (White or Weymouth Pine), readily known from every other American species by its slender leaves in 5's, and pendulous cylindrical cones, longer than the leaves, with loose scales. The Hymalaya mountains likewise afford a species very similar to the *Strobus*, *P. excelsa*. One

of the most useful and prevalent species is the southern states is the *Pinus palustris*, or Long-leaved Yellow Pitch Pine, which occupies, in predominating abundance, a vast extent of sterile maritime district, from Norfolk, in Virginia, to an indefinite distance on the coast of the Gulf of Mexico. Its leaves grow by 2's, and are mostly 12 to 16 inches long, chiefly growing at the extremities of the branches; the cones are also proportionably large. Its timber is much used, and it affords a great part of all the turpentine, resin, and pitch exported from the southern states.

The third section of *Pinus* is that of the Larch (*Larix*), principally distinguished by its deciduous clustered leaves, which are slender as threads. The Larches, of which there are 2 species in the United States, and one in Europe, grow generally in swampy grounds, and their bark is esteemed for tanning. Like all the other sections of the genus, their branches come out in pyramidal stages.

The *Cupressus*, or Cypress, belongs also to the CONIFERÆ.—Its *sterile flowers* are in ovate aments, with peltate scales. There is neither calyx nor corolla; and 4 sessile anthers. The *fertile flowers* are in a cone or strobilus with peltated scales, and are equally destitute of calyx or corolla. The germs are 4 to 8 under each scale of the strobile, and to these succeed angular, compressed nuts. The most celebrated and majestic species of this useful genus is the Cedar of Lebanon, which forms a large spreading topped tree, and like the Larch, is clothed with clustered filiform leaves, which are evergreen, and not deciduous as in the latter. The funereal Cypress (*Cupressus sempervirens*), chosen by the ancients for its sombre verdure, and elegant close pyramidal form, was planted near burial grounds and dwellings. Our White Cedar (*C. thuyoides*) is also evergreen, and has a somewhat sim-

ilar appearance, having flattened green branchlets set with imbricated, minute leaves, in 4 rows. It bears small and nearly spherical, angular cones. It grows in mossy swamps in such abundance often, as to give its name to such morasses. The *C. disticha*, differs from all the other known species in having deciduous leaves, flat and thin, arranged in 2 rows or distichous :—its *sterile florets* are disposed in leafless panicles ; and the cones large and spherical. Its character is so different from other species, that Mirbel forms of it a peculiar genus, called *Schubertia.* It grows in deep mossy swamps, from Sussex county in Delaware to the coasts of the Gulf of Mexico, and is one of the largest of the American forest trees. It is much used for shingles, and has a remarkable property of sending up branches of its roots, sometimes several feet above the surface, in a conic form, called *Cypress Knees*, which are always destitute of leaves and branchlets.

The genus *Ricinus*, *Palma Christi*, or Castor Oil plant, now often cultivated in the United States for the drug it affords, and not uncommon in our gardens, has no corolla to the flower. That which produces the stamens has a 5-parted calyx. The filaments are divided into many subordinate branches, with numerous anthers. The *fertile flower* has a 3-parted calyx ; 3 bifid styles, and a bristly, 3-celled capsule, containing 3, elastically coated, spotted, or marbled seeds, a kind of fruit common to all the other Euphorbiaceæ. Our common species (*R. communis*) has large peltate, palmated leaves, toothed on the margin, of a glaucous hue beneath, and with glands on the petioles. This plant, with us an annual, is in the West Indies a permanent shrub.

Of the Cucurbitaceæ, or Cucumber tribe, is our common scandent or climbing plant *Sycios angulata*, or single seeded Cucumber, peculiar to the United

States.—Its *sterile flowers* have a 5-toothed calyx ; a 5-parted corolla ; and 3 filaments. The *fertile flowers* are similar, but have a 3-cleft style ; and the Pepo or bristly pericarp is small, dry, and only 1-seeded. The plant is an annual, trailing on bushes near the banks of rivers, in light rich soils. It has cordate, 5-angled, toothed, and scabrous leaves. The flowers are greenish white, and the small fruit is green, clustered, and hispid.

The *Cucurbita*, or Gourd, Pumpkin, and Squash, is chiefly distinguished from the *Cucumis*, or Cucumber and Melon, by having a tumid margin to its seeds ; those of *Cucumis* having seed with an edge. They have nearly all a yellow, 5-cleft, monopetalous, almost funnel-shaped corolla ; and a calyx also divided into 5 segments ; with 3 filaments ; a large berry-like fruit called a *Pepo*, in the Gourd and Melon very large and ribbed ; in the Cucumber rugged and warty.

CHAPTER XXVIII.

OF THE CLASS DIŒCIA.

There is no difference in this class from the preceding but the circumstance, that the perfect and imperfect flowers occupy different individual plants of the same species, hence the appellation of Diœcia, or of two habitations ; and the orders are also taken, as in Monœcia, from the other classes.

In Diandria you will find the Willow (*Salix*), whose *staminiferous flowers* are in cylindric aments (often produced before the leaves), the scales 1-flowered, and mutually imbricated ; with a nectariferous gland at the base of each. There is no calyx or corolla. The stamina also vary from 1 to 5. The *fertile flowers* are similar, but in place of stamens have 2 stigmas,

mostly bifid, succeeded by a small, 1-celled, 2-valved, many-seeded capsule. The seeds are minute, and furnished with a coma or tuft of down. The willow is the type of the natural order SALICINÆ, and scarcely differs from the Poplar in any thing more than the inferior number of stamina. They are among the earliest flowering shrubs and trees of northern climates, to which they are exclusively confined. Some of the species are alpine, and form the smallest shrubs known. Such is the *S. herbacea* of the Alps of Europe, which grows also on the summit of the White mountains of New Hampshire. It is a creeping shrub, scarcely ever exceeding 2 inches in height, with smooth, roundish, veined leaves. One of the most elegant species, remarkable for its pendulous branches, and narrow leaves, is the oriental or Weeping Willow (*Salix Babylonica*).

One of the most extraordinary plants known is the *Vallisneria*, a submersed aquatic plant of the natural order HYDROCHARIDEÆ. It grows in large quantities in the still water of most of the principal rivers near the banks, from Delaware to the Mississippi, and presents partly submerged fields of narrow, linear, 3-nerved, grass-like, olive-green leaves, of a thin and semitransparent substance, as is usual in all herbage growing under water. From the bosom of some of these arise *staminiferous flowers*, contained in an ovate, 2-parted spathe. The inclosed spadix is covered with minute flowers, each consisting of a 3-parted calyx, with 2 stamens. These, when mature, from the depth at which they are submerged, and the shortness of the peduncle of the spathe, have no other means of attaining the surface of the water, but by breaking connexion with the parent. As soon as it arises to the surface, the calyx instantly springs open, and the anthers burst, by which impulse, and the accidents of the element

on which they are launched, they, in fact, migrate accidentally to the vicinity of the *fertile flower*, furnished with a long spiral peduncle, by which it is enabled to attain the surface of the water even at a a variable depth. The spathe of the latter is bifid, and 1-flowered; the calyx 3-parted, and superior; the corolla of 3-petals; the stigma ligulate and bifid; the capsule valveless, 1-celled; and the seeds numerous, attached to its sides.

In TETRANDRIA will be found the Wax Myrtle, Bayberry, and Gale (*Myrica*), which have ovate-oblong aments, with lunulate (or crescent-shaped) scales. The *infertile flowers* have 4 to 6 stamens; and 4-valved anthers. In the *fertile flower* there is a single germ, 2 stigmas, succeeded by a 1-celled, 1-seeded drupe. Of the species, the most remarkable is the Wax Myrtle (*M. cerifera*) having wedge-shaped, lanceolate leaves, with a few serratures towards the extremity. This species, with the surface of the leaves scattered with aromatic glands, is a rather low and spreading shrub, abundant on the sandy beaches and hills near the ocean; and in the autumn covered with sessile, crowded, small berries, covered with a roughish coating of whitish green wax, often separated and collected by boiling, for the purpose of making lights or candles. This genus belongs to the family of the SALICINÆ.

The *Viscum*, or Misseltoe, of the natural family of the LORANTHEÆ, is quite remarkable for its uniform parasitic situation, naturally engrafting itself into the bark and sap-wood of youngish or smooth barked trees, where it forms an evergreen small bush, with opposite or forked, green, and brittle branches. The calyx consists of an entire, or but little prominent margin. The petals 4, short and united at the base.—In the *staminiferous flower* there are 4 sessile anthers adnate

with the petals. In the *fertile flowers*, a germ crowned with the margin of the calyx; 1 stigma, and a globose, 1-seeded berry. The only species indigenous to the United States is the *V. verticillatum*, which grows as far north as the lower part of the state of Delaware. In this the branches are opposite, the leaves are wedge-oval, 3-nerved and obtuse; the spikes axillary and solitary; the sterile flowers mostly trifid, and the berries white, adhering, when mature, to the trunks of trees and their branches by means of the viscid pulp with which they are filled.

In PENTANDRIA is arranged the Hop (*Humulus*) of the natural family of the Nettles, or URTICEÆ. But one species is known, a twining tall plant, growing occasionally in alluvial soils, with opposite, 3 to 5-lobed, rough leaves.—The *staminiferous flowers* have a 5-leaved calyx. The anthers have two pores at their extremity. There is no corolla. The *fertile flowers* collected into aments, have a 1-leaved, large, persistent, concave, entire calyx; no corolla; 2 styles; and 1 seed. At the base of the calyx there is produced a coating of diaphanous yellow glands, soluble in warm water, and to which the Hop owes all its bitterness. This extractive matter has been termed *Lupuline*.

The Hemp (*Cannabis*), also of the natural family URTICEÆ, has a 5-parted calyx in the *staminiferous flowers*, and no corolla. The calyx of the *fertile flower* is 1-leaved, entire, and bursting on the side. In this there are 2 styles; and the seed is a bivalvular nut within the closed calyx. There is only a single species of the genus known; occasionally cultivated in the United States. It is a curious fact, in the history of the sexual system of Linnæus, that pistilliferous plants of the hemp have been known to produce fertile seeds when cut off from all access to the staminiferous individual.

In the order HEXANDRIA is the genus *Smilax*, or Green Briar, a group of climbing thorny shrubs, with smooth, shining, thickish, entire, cordate or elliptic, nerved leaves; of the natural family of the ASPARAGEÆ.—The *staminiferous flowers* have a 6-leaved calyx; no corolla; the anthers adnate to the filaments. The *fertile flowers* have a minute style, and 3 stigmas; the berry is superior, 3-celled; 1, 2, or 3-seeded. The most remarkable species is the *S. herbacea*, dying down to the ground annually; with heart-shaped leaves, above verticillated; sending out long axillary peduncles, with umbels of greenish flowers, smelling like the most fœtid carrion or *Stapelia* flowers. The root of a particular species of this genus is the *Sarsaparilla* of medicine.

The *Gleditscia*, or Honey locust, is a genus of spiny trees, of the natural family of the LEGUMINOSÆ, and peculiar to China and North America. They have bipinnated leaves, consisting of many small and partly elliptic leaflets. The flowers are small, greenish, and inconspicuous, disposed in axillary aments.—The *perfect* ones have a 6 to 8 parted, deciduous, equal calyx, of which, 3 or 4 of the exterior segments are smaller; and there is no corolla; the stamina 5 to 6, rarely 8. The legume is flatly compressed, containing only one, or many seeds (often imbedded in a sweetish eatable pulp, and hence the common name). In the *sterile flower* the calyx is partly turbinate (or top-shaped), 5 to 8-parted, with 3 to 5 of the segments interior. The stamina 6 to 8. Our commonly cultivated species, indigenous to most of the western states, is the *G. triacanthos*, translated 3 thorned Acacia, from the spines often occurring trifid. On the trunk, however, in youngish trees, the spines, in reality abortive branchlets, are large and ramified, but occasionally plants occur without any armature. In the southern states

there is a lower growing species, with a 1-seeded, elliptic legume (*G. monosperma*). In the vicinity of the Rocky mountains, towards the sources of the river Platte, Major Long's exploring party collected specimens of a very dwarf species, with entire, linear-oblong leaflets. The *G. brachyloba* of the Mississippi is almost intermediate with *G. monosperma*, and the common species, having shorter pods than the latter, disposed commonly in clusters. This genus, and *Gymnocladas*, which we shall presently describe, presents us with a remarkable anomaly in the regular structure, and deficient number of parts in the flower, compared with the more perfect LEGUMINOSÆ. The calyx, with its 3 or 4 internal or petaloid divisions, sums up only 6 to 8 parts, in place of 10, and these without any of the irregular or papilionaceous character. The stamina are equally deficient in number, varying from 5, 6 to 8, in place of 10. We may thus perceive the small importance of the mere number of parts, and their declension of form from regularity, as all these structures unite here in the same very natural family.

In the order TRIANDRIA (formerly in the complex class and order POLYGAMIA *triœcia*) you will find the genus *Ficus*, or Fig, of the natural family of the URTICEÆ, or Nettles, extremely remarkable for containing, as it appears, the flowers within the fruit. This fruit is then, botanically considered, only a juicy, connivent, or ventricose receptacle, within which are concealed the flowers and seeds of extreme minuteness, but obvious enough through a moderate microscope. Within the top-shaped, converging, and fleshy receptacle, the Fig, whose orifice is closed by scales, you will find a multitude of little flowers of different kinds, complete and incomplete, sometimes in the same fruit, and sometimes on different plants.—The *staminiferous flowers* have

a 3-parted calyx, and 3 stamens.—The *pistiliferous flowers* have a 5-parted calyx, one style, and one roundish compressed seed; in neither of these flowers is there any corolla. Though there are many species of the genus, scarcely any but the common kind and its varieties are eatable.

In the order Octandria you will find the genus of the Poplar (*Populus*), differing but little from the Willow, except in habit, and referred to the same natural family. The aments are cylindrical, with the scales lacerated.—The *sterile flowers* have from 8 to 30 stamina, seated on a turbinate, oblique, entire calyx.—The *fertile flowers* have also a turbinate calyx; 4 stigmas; a superior capsule of 1 cell, and 2 valves, with many small seeds; the seeds surrounded with long hairs. Nearly all the species are trees, with the flowers preceding the foliage. The leaves are, generally, either broadly cordate, or triangular. The petiole in several is compressed vertically towards its extremity, so as to communicate a remarkable vibratory or trembling motion to the leaves, for which the Aspen is well distinguished.

The *Diospyros*, or Persimmon tree, placed here in the present method, belongs to the rare natural order of the Ebenaceæ. Most of the species are tropical. Our *D. virginiana* is a very leafy, deep green, rather small tree, filled with yellow, eatable and sweet, astringent, plumb-like fruit, only matured by exposure to the autumnal frosts. This tree is indigenous to the United States, from the state of New York to Florida.—The character of the genus is, to have a 4 to 6-cleft calyx; an urceolate monopetalous (yellowish) corolla, with a 4 to 6-cleft border. The *sterile flowers* have 8 to 16 stamens; each filament often producing 2 anthers.—In the *fertile flowers* there are 4 to 5 stigmas, succeeded by a berry, with 8 to 12, large, elliptic seeds.

In the order Enneandria will be found a curious, but inconspicuous flowered plant, which I have called *Eudora*. It is the *Elodea* of Michaux, but not the same plant of the same name, of former botanists, which is related to *Hypericum*. It is distinctly allied to *Vallisneria*, and belongs equally to the natural family of the Hydrocharideæ. There is but one species hitherto known in the United States. Richard speaks of a second in Cayenne, in tropical America. Our plant is a submerged aquatic, somewhat resembling a moss, of a dirty olive green color, growing on the muddy margins of ponds and still streams, from Canada to Florida, if not further south. The roots are perennial, the branches diffusely forked or dichotomous, thickly set with linear, or oblong, small leaves, finely and minutely serrulate on the margin, and growing verticillated by 3 or 4 at a joint; from the axils of these arise, about midsummer, the 2 kinds of flowers, each at first, protected in a bifid spathe.—In the *sterile flower* (often produced at the extremity of a very long, flaccid, slender peduncle) there is a corolla of 3 petals, and 9 stamens disposed in 2 ranges, 3 of them being interior, or, as it were, in the relative place of the pistillum. From the slenderness of the peduncle, which is also frequently abortive, the flowers may often be seen floating at large and separated from the parent plant, like the floscules of the *Vallisneria*. The instant they attain the surface, they burst open with elasticity, as well as the cells of their anthers. The pollen is large and granular, the particles spheroidal, and adhering together by 3's or 4's.—The *fertile flower* has a 3-parted calyx, and its tube identic with the very long apparent peduncle. The petals are 3. There are also 3 sterile filaments. The pericarp is an utriculus, or unopening integument, including about 3, rather large mature seeds, the form of which is cylindric.

In the order DECANDRIA is the *Gymnocladus* or Coffee-Bean tree, another anomalous flowered plant of the LEGUMINOSÆ. The name of this genus, given by Lamarck, alludes to the naked or stump like appearance of the branches of this fine tree, common in the western states, south of Ohio and on the great alluvial forests of the Mississippi. The leaves are very large, and compounded 2 or 3 times of broadish elliptic leaflets. The flowers, not very conspicuous, are disposed in short terminal racemes, having a tubular 5-cleft calyx; and 5-petalled corolla.—In the *sterile flower* there are 10 stamens.—In the *fertile* 1 style, succeeded by a 1-celled legume, containing a pulpy matter. The seeds are round, lenticular, large and hard, and when roasted not unpleasant to eat. The pulp of the pod is strongly cathartic. This genus affords us another example of a leguminous plant with a regular corolla and uncombined stamens.

To the order MONADELPHIA, of the present class, is referred the Yew and Juniper. The appearance of the latter evergreen is too familiar to require description.—The *sterile flowers* are in ovate aments, with the scales verticillate and peltate. The anthers are 4 to 8 and 1-celled.—In the *fertile flowers* the aments are globose, the scales 3, growing together; the stigma gaping; the berry containing 3 bony or hard seeds, surrounded with the united and fleshy scales of the ament which forms the berry. Our Red Cedar is a Juniper, bearing much smaller fruit than the common kind. Of the *J. communis*, New England affords a peculiar variety, or rather a distinct species, called *J. communis, β. depressa*, remarkable for its spreading prostrate stems and branches, which rise only at the extremities.

The Yew (*Taxus*), belonging also to the natural family of the CONIFERÆ, has no proper perianth, the flowers only surrounded with imbricated scales.—In

the *sterile flower* there are 8 to 10 stamens with peltate anthers.—In the *fertile* no style. A concave stigma, succeeded by a fleshy drupe, like a cup, open at the extremity; the nut is 1-seeded. Of the genus, our northern dark Fir-woods afford a single native species (*T. canadensis*) only 2 or 3 feet high, running at the root, so as to grow in quantities together. Like the other species, it is an evergreen with linear, distichous leaves, revolute on the margin, and bearing, like the Yew-Tree of Europe, red cup-shaped, sweetish berries. The leaves are said to be poisonous.

CHAPTER XXIX.

OF THE CLASS CRYPTOGAMIA.

This class presents a grand exception to all the preceding in the Linnæan system, for here neither stamens, pistils, nor proper seeds, are any longer recognizable. A different, though obscure, economy prevails, and hence the name of the class, already explained. The plants of Cryptogamia form, indeed, a separate grand division of the vegetable kingdom, presenting several natural, but very distinct, orders. The first is that of

The Ferns (Filices).

These are conspicuous and well known plants, found in all climates and countries, from the arctic circle to the tropics. Some of the species in warm climates attain the magnitude of trees; their leaves are called *fronds*, and are of one continued substance with the branch, often beautifully and very intricately divided and subdivided in the manner of a compound plume.

Their composition presents a fine lace-like net-work, or labyrinth of veins or vessels. The fructification, without any proper visible flowers, is seen commonly to occupy the *under* surface of the frond, in the form of round or oblong dots, or marginal lines, turning brown on attaining maturity. These mere dust-like spots and lines, when examined through a good microscope, are found to consist of dense clusters (botanically termed *sori*), of minute, flattish, circular capsules, at first entire, but afterwards bursting elastically and irregularly through the contractions of the jointed ring by which each of them is respectively surrounded. They contained seed or *sporæ,* as it is called, differing from ordinary seed, is like an impalpable powder, as light commonly as the air, and wafted abroad to any height or distance, so that it is not surprising to perceive Ferns growing high on the trunks of trees, or on the summits of lofty and ruined buildings. That they are not more common, may be accounted for, in the absence of the great degree of requisite moisture and shade necessary to their germination and growth.

The Ferns present two very distinct divisions of kindred genera: namely, those which produce their *sori* on the under side of the fronds, and have *capsules surrounded with the articulated ring;* and others, such as the *Osmunda*, which have rather conspicuous, bivalvular capsules, like two cups edge to edge, *without the jointed ring*, and collected together, either on a separate independent frond, or on distinct parts of one.

The common Polypody (*Polypodium vulgare*) often green throughout the winter, and growing on the shelvings of moist shady rocks, will afford a familiar example, of the true or dorsiferous Ferns; that is, such as have the fruit on the under side of the frond, and furnished with the jointed ring. In this genus, the *sori* (or

small clusters of capsules) are nearly round, and scattered without any regard to order ; they are, likewise, without the protecting scale or involucrum so distinct in

Aspidium, or the Shield Fern, whose *sori* are likewise roundish or elliptical and scattered, but, at first, defended by an umbilicate or centrically attached common scale or involucrum, which either opens all round, or only partially, and then appears reniform or kidney-shaped. Of the genus *Aspidium* there are 13 or 14 species in the United States, some of them common to Europe, and they are generally the most frequent Ferns we meet with.

The most common Brake, however, both in Europe and North America, is the species of *Pteris* called *P. aquilina*, bearing a large solitary branching frond, and having, according to the genus, the *sori* forming a *continued* marginal line, and with the scaly involucum simply formed of the inflected margin of the frond, and opening inwards.

In *Adiantum* (Maiden hair) the *sori* are likewise marginal, but somewhat oblong, and not continuous, merely terminating the edge of each distinct lobe ; the involucrum is similar and likewise opens inwards.

Capsules destitute of the ring.

In this section you will find the *Osmunda*, or Flowering Fern (*O. regalis*), a large and very elegant species, common in most of our dark swamps, with twice pinnated fronds, terminating in panicles or branches entirely devoted to the production of the conspicuous capsules, which are globular, pedicellated, striate, and only half way divided into 2 valves. There is no involucrum. Another very common species, in similar situations with the preceding, is the *O. interrupta* (Interrupted flowered Osmunda). This species grows in

clusters, and flowers early in the spring, before the complete developement of the fronds, which are smooth and simply pinnated, with the divisions pinnatifid, the segments oblong and destitute of serratures; the fruit-bearing divisions blended with those which are infertile.

The most elegant and curious Fern in the United States, but everywhere uncommon, is the *Lygodium palmatum*, with a long slender twining stem, and conjugate or opposite fronds, which are palmated with 5 entire lobes. The summit becomes a fruit-bearing panicle.—The capsules are arranged in 2 series on the back of appendages to the frond, and are radiately striated, lined, or wrinkled, opening on the inner side frome the base to the summit. There is here a scale-like involucrum covering each capsule. This singular and beautiful plant is met with from the neighborhood of Amherst in Massachusetts to the islands of the West Indies.

The Club-moss (*Lycopodium*) presents distinctions sufficient to entitle it to form the type of an order (Lycopodineæ) apart from the true Ferns. We have 12 or more species, several of them not uncommon in moist woods, beneath the shade of evergreens. They send out creeping stems, at intervals giving off low erect branches, clothed with evergreen, leaf-like, minute, or moss-like fronds. The fructification commonly occupies a separate scaly peduncle, ending in 1, 2, or 3 club-shaped spikes. These capsules, axillary, and sessile in the bosom of so many bractes or scales, are 1-celled; some of them 2-valved, and filled with a farinaceous substance; others are 3-valved, containing from 1 to 6 globose bodies. The pollen-like powder, or *sporæ*, at certain seasons, is so abundant as to appear like a shower of sulphur, and is highly inflammable.

The Shave-Rush (*Equisetum*), common in moist meadows, is also the type of a distinct order (EQUISETACEÆ). Their stems are leafless, striated cylinders, either undivided or verticillately branched, the joints surrounded with toothed sheathes. The vernal or flowering stems, for the most part quickly perish, but are succeeded by others which are barren and durable.—The *fructification* occurs in terminal spikes made up of peltate many-cornered scales, on the under side of which are from 5 to 7 sac-like involucra, opening lengthwise on the inner side. The *sporæ* included in the involucrum are numerous, green and globular, with 4 filaments at the base of each, which are dilated at the extremity.

THE MOSSES (MUSCI).

These are a very peculiar tribe of diminutive plants, of an olivaceous or dark green color, presenting commonly large clusters of low forked branches arising from creeping roots, and clothed with minute or microscopic leaves, often closely imbricated or crowded in regular rows. From these arise, generally, capillary peduncles terminated by oblong or cylindric capsules, not preceded by flowers, having the summit at first, protected by a deciduous veil or *calyptre* in the form of an extinguisher or long cone. After the fall of the calyptre, the summit of the capsule becomes visible; it is sometimes closed by a lid, but the margin or *peristome* is almost universally edged with a beautiful symmetrical fringe of hairs or processes, differing in number and form, according to the genus, and arranged either in a single or double series. These hairs are by 4's, or multiples of that simple number, as 4 in the *Andræa* and *Tetraphis*, in others 8, 16, 32, or 64. One of our most common kinds is the Hair-

moss, or *Polytrichum commune*, which in the northern climates of Europe becomes long enough for brooms; with us it is always much shorter. In this genus the capsule is covered by a hair-like brown calyptre; beneath, the capsule presents a lid or operculum, and finally appears a double peristome or fringe, the outermost consisting of 16, 32, or 64 short, flat, inflected teeth; the interior membranaceous and flat.

One of our most common genera is the *Hypnum*, a large creeping kind of Mosses common on the ground. The capsules come out laterally from a cluster of scales. The peristome is double; the outer of 16 teeth dilated below; the inner membranaceous, variously toothed and torn, but commonly in 16 processes, with smaller capillary ones interposed. The calyptre is smooth.

These characters are entirely microscopical, as, indeed, are also the specific distinctions, and the instrument employed must have a considerable power to bring them into view.

SEA-WEEDS (ALGÆ), LIVERWORTS, AND LICHENS.

This order of Linnæus has been divided into the 3 above mentioned. The Sea-weeds, or proper ALGÆ, have leather-like, olivaceous fronds, with the sporæ inclosed in bubble-like, or inflated portions of the frond. The Liverworts (HEPATICÆ), containing but few genera, are allied on one hand to the Lichens, and on the other by *Jungermannia*, apparently, to the Mosses, though somewhat obscurely. The LICHENES, formerly the genus Lichen, includes a large group of very natural and closely allied genera of various aspects. Some of them resemble foliaceous and leathery expansions or fronds, which cling to stones or to the bark of trees. These occasionally present roundish, wart,

or shield-like bodies, of a darker or different color from the frond on which they grow, and contain the sporæ. Many of these foliaceous Lichens give off an abundance of viviparous progeny in the bran-like scales with which they may often be seen covered; these scales, like the shoots and buds of phenogamous plants, are so many living germs of independent existence. Other Lichens appear intricately ramified like trees in miniature. Such are the Rein-deer Moss (*L. rangiferinus* of Linnæus), whose fruit appears in the form of brown tubercles. Another species of this subgenus (*Bæomyces cocciferus*) presents warts of a brilliant scarlet. This species is not uncommon on decayed wooden fences in moist situations. Some of these plants are employed in dying, and the Iceland moss (*Cetraria Islandica*) is used in medicine.

Fungi, or Mushroom tribe.

These plants have an appearance altogether different from the rest of the vegetable kingdom. They all agree in being destitute of verdure, often of very quick growth, and short duration. They form various genera, extremely simple in their structure, with very obscure fructification, and many of them growing in dark or even subterraneous situations. The Mushroom genus (*Agaricus*) contains the common eatable species (*A. campestris*), distinguished by the following characters; it bears a convex, scaly, white cap or head, supported on a stipe or stalk; the whole at first covered by a valve or wrapper which bursts by the sudden growth of the stipe. In the Mushroom the gills, or *hymæneum*, is almost of a flesh-colored red, turning dark by exposure to the air, and at length nearly black. If the Mushroom be left for a time on a plate of glass, a powder will be found deposited of a

whitish color, which is the sporæ or organic germs. That these are capable of germination, like the prolific sporæ of the Ferns, is evident to those cultivators who now form artificial Mushroom beds by strewing the decayed plants on prepared banks of manure.

The genus *Boletus* which affords the spunk or Touch-wood, resembles the Mushroom generally, but has the under side of the pileus or cap pierced by numerous pores in place of gills.

In the genus *Phallus* is found the esculent Morel, which has an ovate, cellular pileus, with the stipe naked and wrinkled. This species is not uncommon in the shady forests of Pennsylvania, and on the banks of the Mississippi and Missouri.

The Truffle or Esculent Puff-ball (*Licoperdon Tuber*) of Europe, is a solid, globular, externally rough fungus, filled with farinaceous sporæ, is without root, and grows wholly under ground. The common Puff-ball is known to every one.

The *Tuber cibarium*, said to have been also found in the United States, is collected for food in Europe and Asia. It grows above the earth, is globose, solid, destitute of root, and at length becomes black and warty. In this genus, among the most simple of all organized bodies, the substance of the fungus is merely variegated with sporiferous veins.

The subterraneous Tuber, however, of the southern states, esteemed as an article of food, is probably the *Sclerotium Cocos* of Schwartz and Schweinitz. It is as large as a human head, exactly of the form of a Cocoa-nut, and is covered by a ligneous, fibrously scaly, hard, brown bark; internally filled with a somewhat fleshy, cork-like matter, when in perfection approaching to a flesh-color. It is scarcely acted upon by any reagent, and remains unaltered for months, when macerated in water, having no fermentible sub-

stance. In this genus the form varies somewhat; it is internally solid or filled up, and of a similar and smooth substance within; but in some species it becomes wrinkled externally. Nothing, really organic can be of a more simple structure than the subjects of this genus, and particularly the present gigantic species. Yet still, these almost amorphous masses are subject to life and death, experience growth, and give origin, as parents to a renewed progeny. No real affinity then subsists, even here, with the mineral or inanimate kingdom, whose respective particles have no limited tie of existence, and remain unalterable and inert, being alone subject to the laws of chemical relation.

PART II.

PHYSIOLOGY OF PLANTS.

CHAPTER I.

REMARKS ON THE GENERAL CHARACTER OF PLANTS.

BESIDES the consideration of plants as mere objects of a system and holding a relation to each other, they deserve a higher regard as forming an eminent part of living and organized nature. Like animals, they are subjects of life and death, and only differ essentially from that higher order of beings in the want of evident sensibility, for the few apparent and equivocal exceptions to this universal rule, in the plants termed sensitive, do not militate against its general application. Nothing like nerves or a nervous sensorium are to be found in the vegetable kingdom, and, consequently, no display of that motion, energy, or irritability which belongs to the government of the different senses. The propulsion of the sap, derived alone from a fluid pabulum, and its elaboration in the vegetable tissue, into which it immediately enters, appears at once the simple source and cause, of all that inappreciable motion in this tribe of beings, which we term growth or developement.

The display of vegetable vitality, is, in many instances, periodical. In those plants, which we indefinitely term annuals, the whole period of existence ter-

minates in a few months, and from the seed alone, is then to be obtained a new generation of the species. But in our perennial plants, trees, and shrubs, which often die to the ground, or cast off their leaves at the approach of winter, though the motion of the sap is arrested by the influence of the cold, and the generation of the year perishes; yet, besides the seed, nature has here provided an ample source of regeneration in the innumerable buds, formed and ingrafted in the alburnum or sap-wood of the root or stem; by this means, at an early season of the year, an invariable supply of vegetable beings are as plentifully produced as required by nature. The buds of each tree or plant, containing within themselves, individually, all the rudiments of so many distinct vegetables, may be transferred by ingraftment or growth in the earth, and thus form as many distinct individuals, each again subject *ad infinitum* to produce an additional ingrafted progeny of buds and branches. The numerous buds of each tree, nourished through the common medium of the trunk and branches, perish after developement and maturity, and are succeeded anew by another generation of ingrafting or protruding buds, for which they have provided by the deposition of the alburnum. The growth of every tree, as well as herb, is then strictly annual, and the trunk is produced by a curious junction of dead and living matter. The rings of wood, which may be counted in the transverse section of a tree, not merely indicates its age, but the number of *distinct* generations of spontaneously ingrafted individuals which it has sustained. In the animal kingdom, among the order Moluscæ, examples of this kind of aggregation are not uncommon, where many animals are inseparately connected, and nourished through a common medium. This agamous race of plants are always similar to the pa-

rent from whence they have originated, as we all know by the process of budding and ingrafting; to say that these buds or grafts partake of the age and accidents of the trunk on which they were evolved, is improbable, if not impossible, as they can, in fact, be influenced only by the stock to which they are last transferred.

But the most obvious display of vitality in the vegetable kingdom is the generation of a new race from sexual intercourse, consequent on which the seed is produced; in fact, an ovum like that of the birds and insects, containing a *punctum saliens* awaking to life on the congenial addition of the requisite heat and moisture. This progeny of the flowers, though specifically similar with the parent, is yet often subject to considerable variation, as in the races of the animal kingdom.

The infant plant is, for a while nourished with a ready formed supply of nutriment contained in the mass of the seed, or in the infant leaves (*cotyledones*), which it first produces. The vortex of vitality, influenced more or less by external causes, is now destined to continue its operation as long as the plant happens to live; (for the death in the vegetable kingdom which we see take place in a tree or shrub, is ever the effect of accident, as we have already remarked, that no race of vegetable beings continue to live for more than a year).

Plants, like animals, consist of fluids and solids. The sap, almost similar to the veinous blood in its functions, is commonly imbibed from the bosom of the earth by means of the fibres of the root. When it first enters its composition is very simple; it is propelled upwards by a system of tubes or vessels, but is not prepared or elaborated by any thing like a stomach, as in animals, the fibres of the

root perform this selective office, but so involuntarily, that poisons to the vegetable structure, if present, are almost as readily absorbed as matters of nourishment. The sap, at length, conveyed into the leaves and green twigs is there exposed to the action of the light and the air, admitted by cortical pores, as in the lungs or gills of animals; and here in its descending course, it becomes prepared to supply all the solids and other peculiar products which characterize each particular species of vegetable.

The constitutions of plants are more variable than those of animals, so that they are fitted, in great variety, to occupy the whole surface of the earth. The arctic regions have their particular tribes of plants, as well as the luxurious region of the tropics, where frost is unknown. At one extremity of the earth, or on the snowy summits of the loftiest mountains, vegetation only actively lives about two months in the year; in this short period the dwarf productions of this region of ice, flower and perfect their seed, or prepare a new generation of buds, and then again fall into a state of dormancy, and commonly remain buried beneath their congenial snows. Within the tropics, a region which may truly be termed the paradise of plants, the utmost variety prevails. Within the compass of a few leagues thousands of species may be enumerated; while the whole Flora of Spitzbergen contains only about 30 species, and all of them dwarf herbs. In the tropics, trees and shrubs are almost as numerous in species as herbs. The trees attain the most gigantic magnitude, and the forests, filled with evergreens, are nearly impervious to the rays of the vertical sun; here the vegetables continue throughout the year in a state of active growth; dormancy in many of these plants would be instant death; the stream of vitality continues without interruption, and cold, before it attains the freezing tem-

perature, is capable of destroying the tender vegetables of this favored region. These plants, however, by their inherent and constitutional temperament are enabled to resist, like animals, the destructive and drying effects of the great heats to which they are exposed. So, also, the trees and shrubs of cold climates retain the necessary moisture of their vitality at temperatures, when all other liquids freeze.

The presence of organic life, inherited from preceding individuals or parents of the same species, and only continued for a very limited period, under the conditions of a vital movement of certain assimilating fluids, like the circulation of the blood of animals, is a character common to all vegetables. They have, also, an inherent constitution varying with the climates and the soils they occupy. They are stimulated passively by light, heat, and the ingredients of the soil. Their abundance appears to be infinite; and created principally for the subsistence of animals, their destruction as well as growth, is interminable. But, though living, they are formed without sensibility, and without sentiment; they have neither nerves nor senses, wants nor pains, that are capable of any perceptible expression. In the absence of nutriment they perish, with it they thrive; but show no more appearance of attachment to existence, nor resistence to that which causes its destruction, than the crystal of salt does to the contiguous agent which effects its solution or decomposition.

CHAPTER II.

GENERAL COMPONENTS OF THE VEGETABLE STRUCTURE.

VEGETABLES, like animals, are composed of fluids and solids. The fluid parts produce those which are solid ; and the only pabulum of plants being liquid, it is necessary that there should be an organic vascular system for its distribution, and that it should, no less, possses the vital power of assimilation, in order to supply the growth which takes place, and to diversify the products which characterize every species of perfected plant.

The general solid components of the vegetable system are ; the *membranous*, the *cellular*, the *vascular*, and the *glandular textures ;* the *ligneous fibre*, and the *epidermis*.

The general fluids are the *sap* and the *proper juice*.

I. OF THE SOLID COMPONENTS *

The first which we shall examine is the *membranous texture*, consisting of an exquisitely thin transparent, colorless, film-like membrane or pellicle, found in every individual of the vegetable kingdom. The nicest microscopical examinations are unable to throw any light on its intimate structure, so that no appearances of organization have yet been detected in it. It is that component of the vegetable structure, which constitutes its basis ; or which in it lax state forms the cellular and the glandular textures and the epidermis ; a little condensed it constitutes the vascular texture, and perhaps still more consolidated forms the ligneous

* For the plates illustrative of this part of the subject, see the end of the volume.

fibre ; so that it enters into the whole of the solid materials of the vegetable.

The *Cellular texture* is formed from the membranous. It presents, in the parts of a plant where it is not compressed, the appearance of hexagonal cells, resembling those of a honeycomb. Mirbel discovered that they are similar to the geometrical cells of a honeycomb, although sometimes of a longitudinal figure, and that the divisions of the membrane which forms them are common to contiguous cells ; that they communicate with each other by means of pores and slits, about the 300th part of a line in diameter ; and that through those perforations, the vegetable juices they contain are slowly transfused. He asserts, also, that these pores are surrounded with borders ; and that the perforations are few and scattered in the true hexagonal cells ; but numerous and arranged transversely in regular series in the longitudinal openings. The membrane itself is so thin, that when examined through a microscope, with the light thrown obliquely upon it it appears iridescent ; but, its organization is too minute to be determined by any magnifying power with which we are acquainted. When separated and put into water it very quickly resolves into a kind of mucilage, but in the living state resists the action of water with which it is often filled.

The cellular texture, in one form or other enters into the composition of almost every vegetable organ. It is dry in some parts, but in other situations it receives and slowly transmits fluids ; and in it, principally, the various secretions of the plant are deposited. Thus, it is generally filled with mucilaginous, resinous, oily, or saccharine juices ; but sometimes the cells contain air only. In the bark of plants the cellular texture is found immediately under the cuticle, filled with a resinous juice, which is of a different color in differ-

ent species of plants, but most frequently green. In this situation it is the seat of the color of the bark, in the same manner as the *rete mucosum*, or reticulated capillary membrane situated under the human cuticle, is supposed to give the color to the skin. The cells are filled with the same green juice in leaves, which are composed of a layer of cellular substance placed betwixt two layers of cuticle. The medulla or pith of plants is, also, composed of these cells, filled in young and succulent plants and branches with water, or wat ry fluids; but in older plants, and in the trunks and branches of trees, not succulent, they are generally empty. In the latter the shape and structure of the cells are most conspicuous, and easily observed. Thus, if a transverse, or longitudinal section of a twig of *Spanish Broom*, in the second year of the growth of the twig, be placed under the microscope, or even a common lens, the pith of it displays in the most beautiful manner the hexagonal cells, the transparent iridescent appearance of the membrane forming their walls, and the situation of the communicating pores. It is well seen also by the aid of the microscope in the pith of many other plants. The petals of flowers are almost entirely composed of cellular texture, the cells of which are filled with juices fitted to refract and reflect the rays of light, so as to produce the brilliant and delicate tints with which the pencil of nature has embellished these parts. In the same manner it enters into the composition of the stamens, the stigma, and even the pollen or fecundating farina of the flower. The fleshy parts also of succulent roots, and of pulpy fruits, are formed of this cellular texture filled with different juices according to the nature of the roots and the fruit.

When the cellular texture is compressed, the cells are found forming nearly parallelograms, as in the

leaf-stalk of the Artichoke, in which they have a somewhat tubular appearance; and by the stretching of the membrane, the pores, which in the hexagonal cells are arranged without any order, are now very regularly disposed. The cells are proportionally more abundant in herbaceous plants than in trees; and in the younger than in the older branches.

Such is the nature and appearance of the cellular texture. There is every reason for believing that it enters as a component into almost every part of the vegetable structure; and anatomy confirms the opinion as far as we have the means of ascertaining the fact. There are indeed some plants, as the Fuci and other marine vegetables which appear to be altogether composed of cellular texture.

The *Vascular texture* is the next of the solids enumerated. It consists of hollow tubes of different forms and structure, which are capable, like the vessels of the animal frame, of conveying fluids. When a succulent stem is cut transversely fluids are seen issuing from different points; and, if the peculiar juices of the plant be of a milky or colored nature, as in the Fig tree, or in any of the species of the genus Euphorbia, they are still more clearly perceived to issue from different points; for instance, the watery or colorless from one set, and the milky or the colored from another. This circumstance leads us to conclude that the sap, or watery fluid imbibed from the soil, is carried in one set of vessels, and that the proper juices formed from the sap by the vital powers of the plant, are conveyed in another; or, that there are *conducting* and *returning* vessels, a fact which has been proved by experiment.

The minuteness of these vessels requires the aid of the microscope for their examination; and even by its assistance as they are not easily seen, owing to

their coats being in many cases transparent, and the fluids contained in them colorless, we are obliged, in order to render them more evident, to have recourse to colored fluids, which are readily observed when the cut ends of twigs or branches are immersed in them; and the course of the vessels through the branch is thus marked by the color. The most eligible fluids for this purpose are decoctions of Brazil wood, and infusions of the skins of black grapes; the plants likely to yield the most satisfactory results to the beginner, are the *Periploca græca*, the *Aristolochia Sipho*, or Dutchman's Pipe, and the young shoots of the Poke (*Phytolacca decandra*). The plant or twig to be thus injected should be cut with a very sharp knife, and its divided end immediately placed in the colored infusion in a warm temperature: after a few hours the color, in plants favorable for the experiment, may be traced into the leaves, the flowers, and even the fruit. This discovers the course of the conducting or adducent vessels; and when the operation is reversed, the twig being cut at its top, and inverted in the colored fluid, we can trace that of the returning or abducent vessels. By placing transverse and longitudinal sections of twigs and parts of herbaceous plants thus treated under the microscope, we are able to ascertain the organization of the coats of the vegetable vessels. Some of the vessels, however, cannot be rendered more visible by this means, as they refuse to admit colored fluids, and therefore any knowledge of their structure can be obtained only by means of powerful microscopes.

The *Vascular* or tubular portion of the vegetable structure composes a kind of net-work, owing to the frequent communication or anastomosis of the vessels with one another, which pervades almost every part of the plant. The particular vessels vary both in form

and in the diameter of their calibers. They are composed of the membranous texture, are firm, comparatively thick, and somewhat pellucid. Mirbel describes 6 different kinds of vessels; but the whole may be arranged under the 3 following genera: viz. 1st. Entire vessels; 2d. Perforated vessels; 3d. Spiral vessels.

1st. The Entire vessels are, as their names import, simple tubes formed of imperforated membrane. They are cylindrical; and are generally in bundles, regularly disposed in the cellular part of the bark. They are found in the young shoots of almost every kind of plant; and in the fasciculated state may be readily detected, and examined by the aid of magnifying glasses, in the leaf-stalk of the common Fern, in the Arrow-head (*Sagittaria sagittifolia*), and in the Hemp plant. In order to examine them individually, the bundles should be steeped in spirits of turpentine for a few days, by which means the vessels can be easily detached from one another.

These vessels are intended to convey the proper juices of the plant, and are generally found filled with oils, and resinous juices; consequently they are more numerous in plants, the juices of which are of a thick resinous nature; and these drying along with the condensed vessel in the bark, are the matters on which the medicinal virtues of barks in general depend.

2d. The Perforated vessels are cylindrical tubes, the sides of which are pierced with minute perforations variously distributed. They may be divided, according to the character of the perforations, into 2 species; viz. *Cribriform vessels*, the perforations of which are simple pores, arranged in parallel series, transversely and equidistant over the whole surface of the tubes. Mirbel denominates them porous vessels, and asserts, that each perforation is surrounded with

an elevated border ; and observes, that they must not be regarded as continuous tubes, as they often separate, join again, sometimes disappear altogether, and always terminate in cellular texture. They are found in the substance of roots, in the formed wood of stems, branches, leaf-stalks, and the central ribs of leaves ; and are most numerous in hard woods, as of the Oak and the Chesnut. Their pores are so extremely small, that, in order to peceive them, a thin longitudinal slice of the wood to be examined must be cut, and placed in a drop of pure water under a powerful microscope. It has not been accurately ascertained what kind of fluid is contained in these vessels.

A modification of the perforated vessels has the appearance of a string of beads, consisting, as it were, of united portions of a porous tube, narrowed at the extremities, and divided from each other by perforated diaphragms. This variety of perforated vessels is found frequently in roots, and at the going off of branches, and the attachments of leaves, being, says Mirbel, " intermediate between the large vessels of the stem and those of the branches ; and it is by their means," as he conceives, " that the sap passes from the one set of vessels into the other."*

Another variety of the perforated vessels, called *annular*, are so named from the perforations being transverse and oblong, as if the tube were formed of rings, of the same diameter, placed one above another, and attached at some part of their edges, but not touching throughout the whole circumference. These are, in fact, porous vessels, with oblong transverse perforations, resembling in every respect, except shape, the round pores of the last described vessels. They are also surrounded by a border, and convey resinous and

* Elém. de Phys. Végét. 1ere Partie, p. 31.

oily secretions. They are found in greatest numbers in the less compact woody parts of the plant. The centre of the majority of the species of Lycopodum, or Club-moss, contains a thick cylinder, which is chiefly composed of vessels of this kind. Ferns also inclose many of them, in their woody threads; and several other plants, particularly the Vine, the wood of which is soft and porous, and contains them in great numbers.

Each of these species of perforated vessels is occasionally seen forming different parts of the same tube; or one portion of it may present the cribriform characters and another the annular.

3d. The next set of vessels, the SPIRAL, have been known to botanists since the time of Grew, who was the first that gave his attention to the anatomy of plants. They have been named *vasa spiralia*, and *fissuræ spirales* from their appearance; and *tracheæ*, from their resembling the tracheæ of insects, and from an unfounded opinion that they were the vegetable organs of respiration. They are the largest of the vegetable vessels; and in many plants their structure is visible to the naked eye. Thus, if a leaf, or a green twig of Elder (*Sambucus canadensis*), the petiole or peduncle of the Water Lily, or the stem of the common Lilies, or the leaves of various species of *Amaryllis*, when on the decay, or the fleshy scales of any bulb be partially cut, then cautiously broken, and the divided portions carefully drawn asunder, the spiral vessels will be seen appearing like a screw, and their real structure become apparent. They are formed of a thread, turned in a spiral manner from right to left; as if a fine slender and flattened wire were wrapped round a small cylinder of wood, so that the successive rings touch each other, and then the cylinder be withdrawn; the form thus acquired by the

wire will represent the spiral tubes. The thread of which they are formed is elastic, opaque, silvery, shining, and flat; and in several plants, particularly the Banana, the *Hæmanthus*, and several species of *Amaryllis*, is sufficiently strong to suspend the inferior portion of the leaf or twig, if it be not very large; but there is no reason for believing, as Willdenow and others have asserted, that it is hollow, and forms a real vessel thus twisted in a spiral manner; or, that the larger hollow tube is an air-vessel, while the spirally twisted thread is a vessel carrying fluid. For, if we consider the smallness of the larger tube, and the flattened state of the thread of which it is formed, the impossibility of any fluid entering the smaller one, if it really existed as a vessel, may be easily conceived. According to Hedwig's observations, made with a microscope which magnified 290 times, he found that the apparant diameter of these air-vessels, as he supposes them to be, is one tenth of an inch; their real diameter, must therefore, be the 290th part of the tenth of an inch, or the 2,900th, part of an inch. What then, I would ask, must the diameter of the supposed spiral vessel be, and what fluid could be conducted through it? The thread is sometimes double; and Mirbel asserts, that it is furnished with a glandular border.

These vessels are found in great numbers in monocotyledonous plants, as in the centre of the ligneous threads, which exist in the stems of Grasses, and in Palms. They are numerous also in most herbaceous plants; and particularly in aquatics of a lax texture. They are seldom detected in the root, and never in the bark; but are situated round the medulla of the young shoots of trees and shrubs; whence bundles of them are given off, and enter the middle rib of leaves, to be distributed through them under their upper sur-

face. They have been detected, also, in the calyx, and other parts of the flower; and Gærtner asserts that they are evident even in the seed-lobes. The spiral vessels, in their course, proceed always in straight lines, without any deviation; whereas all the other vegetable vessels often take a curved direction. It is into these vessels that colored injections most easily enter; and when an annual twig of the Fig is thus injected, they are seen in a transverse section of it, like red dots around the pith, placed within an external circle of the vessels, which contain the proper or milky juice of the plant.

These varieties of form in the vegetable vessels are not such important differences essentially as the arteries and veins of animals; for in some plants, according to Mirbel, the 3 different modifications of structure are found to take place in the same tube. In the *Butomus umbellatus*, or flowering Rush of Europe, the same author says, "I have seen long portions of vessels present, at intervals, the appearance of an unrolled trachea (or spiral vessel), a transversely cleft vessel, and a porous one.

Mirbel mentions another set of vessels, which he denominates little tubes; but they appear rather as tubular cells, being closed at the extremities. They resemble stretched cellular substance, except that the membrane composing them is less transparent, and of a greater consistence. The solidity of plants depends very much on the quantity and density of these cells, which are filled with thick and colored, or thin and colorless juices, according to the nature of the plants in which they exist.

The structure of the internal *Glandular texture* of vegetables is much more difficult of demonstration than that of any of the general solid components which

have been already noticed: but, when the impossibility of attaining an accurate knowledge of the glands of the animal body, which are large and visible to the naked eye, is considered, it will not appear wonderful that our remarks on this subject are drawn rather from analogy than from actual observation. When, however, we reflect on the nature and diversity of the vegetable secretions, and that plants possessing the most opposite properties rise from the same soil, there appears to be no medium by which the absorbed aliment can be so altered in its characters, except by that of a glandular system. When the eye glances over the number and variety of vegetable products, there is much reason for supposing, that the simple transfusion of fluids can scarcely be sufficient for the production of these changes. We know that the laws of chemical affinity, in the temperature in which they take place, are inadequate to the effect; and, besides, many of the changes produced, particularly those which fit the sap to be assimilated into the substance of the plant itself, are directly contrary to the laws of chemical affinity, which operates in destroying these combinations, as soon as the vital principle of the plant ceases to act. Although, therefore, we cannot by demonstration prove the existence of internal glands in vegetables, yet we have the strongest analogical evidence in favor of the supposition that they do exist. The pores and clefts of the cells and the vessels which have been described are surrounded by opaque regular borders; and even the flat thread which forms the spiral vessels is edged with a similar border. These bodies are regarded by Mirbel as glands; and the opinion receives weight from the circumstance of the mucilage, which is changed into the organized tissue, being found always collected in greatest quantity around those vessels which are most studded with these

opaque borders. If vegetable glands then do exist, they must necessarily enter, as a general component into the structure of every plant.

Besides these obscure internal glands, there are also external bodies, which all Botanists have agreed in considering as glands, and which, in general, separate, as an excretion, some peculiar fluid. Thus honey or a nectarious fluid is secreted at the base of the petals, in the greater number of plants; on the stalks of others, (as the Catch-fly) a viscid substance is thrown out; and on some, perforated hairs or bristles, emit spontaneously a mild, or eject into the punctures they make in the skins of animals, an acrid fluid. Such are the excreting glandular hairs of the Sun-dew (*Drosera*), and the stings of the Nettle and the *Jatropha*.

Of the structure of these glands, although they are external, very little is yet known; and microscopes of the greatest magnifying powers present them as masses of cellular substance only, with vessels passing on to their centre, without developing any other particular organization, which might lead to explain the mode in which they perform their functions. These, however, are, in some degree, obvious from their effects; and afford more than probability to the idea that vegetables possess a glandular system.

The *Ligneous fibre* is a very minute, firm, elastic, semi-opaque filament, which, by its cohesion with other filaments of the same kind, forms the proper fibres, or layers of longitudinal fibres, that constitute the grain or solid part of wood. It enters, also, into the composition of another set of layers, that traverse the longitudinal, named divergent. It is intended, apparently, to give support and firmness to the vegetable body, and hence is found in greater abundance in trees and other perennial plants; and according to the

number of the ligneous fibres in each bundle of layers and the force of their cohesion, the wood of different trees possesses a greater or less degree of hardness. But, although wood is found of various degrees of consistence, yet it is probable that the ultimate fibre may be the same in all plants.

Whether the ligneous fibre be of original formation, or condensed membranous or cellular texture, or an obsolete obstructed vessel, as Hedwig reasonably supposes, is yet undetermined. It is so intimately united with the cellular texture containing the vegetable secretions, that it cannot be procured pure for examination, without the separating aid of chemical agents. If a thin shaving of well dried wood be first digested in boiling water, then in alcohol, and lastly in ether, every thing soluble in it will be extracted by these liquids, and the insoluble part which remains be found to be composed of interlaced fibres, easily subdivided and having some degree of transparency: these are the *ligneous fibres*. They have neither taste nor odor, and remain unaltered by exposure to the atmosphere: but although insoluble in water, alcohol, or ether, the fixed alkalies and mineral acids dissolve and decompose them. The relative quantity of this fibre in any plant may be pretty accurately ascertained, by exposing a given quantity of the wood to a moderate fire, in close vessels, for a number of hours sufficient to convert it into charcoal; for as the wood only becomes charcoal and the other parts are dissipated, the proportional weight of the charcoal obtained shows the quantity of the ligneous fibre contained in the wood. Count Rumford thus found, that the wood of the Poplar, Lime, Fir, Maple, Elm, and Oak, contained each a proportion of ligneous fibre nearly equal to 9 twentieths of their wood in its natural state.

The *Epidermis* is that portion of the vegetable structure which is exterior to all the others; at least to those which retain their vitality in the vegetating state of the plant: or, it is that part which is interposed between the living organs of the individual, and all extraneous substances. In this respect it resembles the cuticle of animals; it extends over the surface of every part of the plant; from that of the delicate petal of the flower, to that of the leaves, the branches, the stem, and the root; but, except in young stems and roots, it is not the exterior part of those organs of the plant; the coarse rugged surface of older roots and stems being exterior to the real epidermis. It is common to every kind of plant, nor can any exist without it. The vegetable epidermis may be separated from the parts, which it covers, by raising it cautiously with a knife; but this is more easily effected by maceration and boiling. It is more readily separated from the cellular substance it covers in the leaf, than in any other part of the plant; and for this purpose I would recommend to the student the leaf of any of the Lily tribe, before the stem shoots up; or of the Lettuce or Sorrel; but even in these, some of the cellular matter is always detached in separating it; and to this circumstance is perhaps to be attributed the variety of opinions which phytologists have advanced regarding its structure.

The epidermis appears at first of a green color on the young stems and branches of almost all plants; but it changes to different hues, according to the age of the part it covers. According to Du Hamel, it is composed of fine, but tough fibres, which are interwoven together; and everywhere interspersed with pores, which permit the mouths of the absorbing, transpiratory, and air vessels to open to the atmosphere. Mr. Bauer, concieves its structure to be altogether

cellular, and varying in different plants. The elder Saussure concieves the epidermis to be a fine, transparent, unorganized pellicle. The pores, by which the insensible perspiration escapes, are so minute, that they are quite invisible, and with difficulty permit the passage of air through them. Thus, if an apple be put under the receiver of an air-pump, and the air withdrawn, the cuticle of the apple will be lacerated by the dilation of the air contained in the pulp of the fruit. There are oblong pores also in the cuticle of herbaceous plants in particular, as was first observed by Decandolle, who named them cortical pores. The size of these is considerably greater than that of the former; and varies in different plants.

The epidermis seems to be entirely destitute of longitudinal vessels. When applied very closely to the cellular layer below it, the greater portion of the light is transmitted through it and reflected from the cellular layer, and not from the transparent substance of the cuticle; so that the color of herbaceous stems or twigs is that of the cellular layer, and not of the cuticle itself; yet in trees and shrubs, which annually renew the cuticle, as the Plane, Birch, Currant, and others, the epidermis, when beginning to peel off, becomes more opaque and does not transmit the light, but reflects it from its own surface. Thus the old cuticle of the Plane (*Platanus*) is dark colored, while the new is of a light green hue; the stem of the Birch, from which layers of epidermis are continually peeling, is white, while the young branches are brown; and the old branches of the Currant are dark brown, while the young shoots are a very light green. In some plants, instead of being thrown off in plates, or in layers, the old cuticle is cracked and reduced into powder.

Although the epidermis is not cast off from all plants

in this manner, yet it is constantly renewed; and, where it remains, the old cuticle cracks as the diameter of the stem of the tree, or of the branch, increases: it is then gradually pushed outwards, and the accumulation of successive layers, in this manner, forms the rugged coats which characterize many trees, as the Elm and the Oak. Various animals also annually cast their skins, and readily renew parts of it which have been destroyed; but in vegetables, this occurs on the stems and branches of perennial plants only; for on annual plants, and on the leaf and flower, it is not renewed after being destroyed. The vegetable epidermis is capable of extention; but this is less considerable than has been supposed; and as there is a constant renewal, there must be a proportional increase or growth of its parts, so that it is not simply extended to enable it to cover a greater portion of surface; but a new cuticle is added to produce this effect.

The use of the epidermis is to keep the parts beneath it together; and to regulate the perspiration and absorption of the plant. It is calculated also to defend the parts it covers from humidity; for which purpose, it is covered with a waxy secretion. The powers of the cuticle in regulating these functions is fixed according to the nature of the plant. In succulent plants, which require much moisture to be retained in their leaves, the cuticle is so constructed as not to assist absorption, but rather to prevent transpiration. Thus, if a leaf of the Aloe be cut off, it will remain a very long time, even when exposed to the sun's rays, before it shrivels; but, if in this state it be exposed to damp air, or thrown into water, the absorption is so rapid, that it will regain its original plumpness and size in a few hours. Another use of the epidermis is to prevent the destruction of the parts it covers: for, as it is

in the vessels of the inner bark that the greatest activity, irritability, and degree of vital energy reside, :f that part be wounded to any considerable extent, so that the external air finds access to it, exfoliation, and the death of the part, and sometimes that of the whole plant, follow.

Such are the principal solid components of the vegetable body. Other solid matters also enter into their structure; but, as they are not common to the vegetable race, they cannot be ranked in the general composition. Perhaps, indeed, all the parts which have been examined may be resolved into modifications of the membranous and cellular textures; but, although we allow that the vessels, ligneous fibre, glands, and epidermis most probably are composed of membranous, or cellular tissue, differently modified, yet as each of these parts possesses very distinct functions, such a refinement could only perplex and bias the observer in search of the truth.

II. General Fluid Components of Plants.

Vegetables, by their vital energy, develope themselves, increase in bulk, and augment the quantity of solid matter they contain, consequently the principles of the solids must be contained in the particular fluids which they select and imbibe from the soil; but in what manner the fluids are changed into solids, and whether any of the solid matters be taken up ready formed, or whether they result from a transformation effected solely by the action of the vegetable vessels, are subjects of consideration upon which it would be premature to enter. These fluids, however, after being absorbed by the roots, enter into and fill the cells and vessels of the plant, and form a very considerable portion of the bulk of the vegetable body. As

soon as they enter the plant, they constitute its SAP, or common juice, to the nature of which, as one of the general components of vegetables, we shall now direct our attention.

The motion of the sap, though constant during the continuance of the life of the vegetable, is still most active in spring and midsummer, at which periods a much greater quantity of fluid is found in the vessels of the plant. The sap is in the same situation for the purposes of the plant, as the chyle of animals is, while yet in the thoracic duct, and before it is mingled with the blood, and exposed in the lungs to be fitted for the purposes of life. Neither is in a proper state for yielding the various secretions, and adding, by the process of assimilation, to the growth of the plant, or of the animal; but the analogy goes no farther. In the animal, the digestive powers of the stomach and the action of the mesenteric glands so change the food taken into it, that no chemical analysis of the chyle produced from it could lead to an accurate knowledge of the food, which had been employed by the animal; but in plants, the food is already prepared in the ground before it is absorbed by the roots, and, therefore, were it possible to obtain the sap from the vessels very near to the extremities of the roots, we should be enabled to discover, with considerable accuracy, the real food of plants. This, however, cannot be accomplished; and as the sap, in its progress, dissolves some ready-formed vegetable matter, which had been deposited at the close of the preceding autumn, in the upper part of the root and at the base of the stem, its original properties are thus altered; and the farther the part, which is bored in order to procure the sap, is from the root, the more vegetable matter this fluid is found to contain. Were it possible to obtain the sap

completely free from the peculiar juice of the plant, it would probably be found nearly the same in all vegetables.

When the sap is drawn from a tree early in the spring, the time when it moves or bleeds most freely, and as near the root as possible, it usually appears nearly as colorless and limpid as water, has scarcely any taste, and no particular odor. A phial containing a certain quantity of sap weighs heavier than the same phial containing an equal portion of distilled water; so that its specific gravity is greater. If it be kept for some time in a warm place, it undergoes sometimes the acetous, at other times the vinous, and in some instances the putrefactive fermentation. These differences would indicate a disparity in the composition of the sap of different plants; but there is every reason for thinking that they depend more on the admixture of the proper juices. The rapid vinous fermentation of some kinds of sap is taken advantage of in warm climates for economical purposes. From the top of the Cocoa-nut palm, the natives of India extract the sap by an incision made in the evening, and receive it in a vessel set for the purpose, this liquor, next morning forms a pleasant, mild, and cooling beverage; but before evening, it ferments and becomes powerfully intoxicating. In Ceylon, arrack is distilled from this fluid; and it also yields, by boiling in the same manner as our Sugar Maple (*Acer saccharinum*), a coarse sugar. In these cases, however, the sap is evidently mixed and combined with the proper juice of the tree. According to Mr. Knight, sap always contains a considerable portion of air. It also differs in its specific gravity according to the distance from the root at which it is taken, the gravity increasing with the distance, arising apparently in some degree from the solution of deposited matter in its progress, but perhaps more from

the transpiration of the plant, throwing off a large proportion of the watery part of the matter taken up from the soil. Such are the sensible qualities of the sap; its chemical properties and composition are discovered by tests, and analysis by heat.

According to Vauquelin, the sap of the Elm (*Ulmus campestris*), collected towards the end of April, the beginning and the end of May, in 1039 parts consisted of 1027.904 of water and volatile matter; 9.240 of acetate of potash; 1.060 of vegetable matter; and 0.796 of carbonate of lime. The second analysis of the sap collected at the beginning of May afforded a greater proportion of vegetable matter, less acetate of potash, and also less carbonate of lime; and in the third analysis of that collected at the end of May, the quantity of the acetate of potash was still more diminished, and also that of the carbonate of lime. In all he found slight traces of sulphate and of muriate of potash. From two different analyses of the sap of the Beech (*Fagus sylvatica*), procured also at different periods of the same season, he obtained water, acetate of lime, free acetic acid, gallic acid, and tanin, with some vegetable extractive and mucous matter. In the same manner he examined the sap of the common Hornbeam (*Carpinus Betulus*), collected in March and April, and found in it, acetate of of potash, acetate of lime, sugar, mucilage, vegetable extract, and water. In the sap of the common Birch (*Betula alba*), be found acetate of lime, acetate of potash, acetate of alumina, sugar, vegetable extract, and water. In all the specimens thus analyzed the quantity of vegetable matter was found to be greater in the sap drawn late in the season, than in that collected at an earlier period of it.

The modifications which take place in the roots of plants, throw considerable obstacles in the way of ob-

taining a perfect knowledge of this part of the vegetable economy; for to obtain such a knowledge of the nature of sap would require an examination of that fluid in a greater number of different species of plants, than the opportunities, and the period of any life, would permit. All that we can aim at, therefore, in the present state of our knowledge, is the formation of a probable hypothesis, rather than the attainment of truth deduced from certain experiments. In this mode of viewing the subject, we may regard the sap of plants as consisting of *water* which is its principal component, *carbonaceous matter*, *acetate of potash*, and *carbonate of lime*; which ingredients are decomposed by the vital powers of plants, and new combinations of their constituents produced by the same powers, so as to form the different parts of which a plant consists. The large portion of vegetable matter contained in the first sap, must have been previously deposited in the cells of the root, and taken up by the water of the sap in its progress upwards: and air which is also found in sap, is either the produce of vegetation, or is taken in by the roots dissolved in the water of the soil.

Such is the nature of the sap. In spring and at midsummer it forms a large portion of the vegetable body; and is carried forward through the vessels, with an impetus sufficient to raise it to the summits of the highest trees, until arriving at the leaves, in which it is exposed to the action of the air and light, the great quantity of water it contains, being no longer necessary, is thrown off by perspiration; whilst the *succus proprius*, or peculiar juice of the plant, from which all its secretions are formed, is produced by the changes resulting chiefly from this exposure. We have, therefore, next to proceed to examine the nature of this peculiar juice, as one of the general components of plants.

The Proper Juice.

When a plant is cut through transversely, the proper juice is seen issuing from both divided surfaces, but in greatest quantity from the open orifices of the divided vessels in the part farthest from the root; a fact which is ascribable to the progression of the proper juice being inverse to that of the sap, or from the leaves towards the roots. It is very often mixed with sap, and cannot be distinguished from it by color; but in many instances it is colored or milky. Thus, if a twig of any of the species of Spurge (*Euphorbia*) be cut, the proper juice issues from the wound in the form of a resinous milky emulsion, and may be obtained in considerable quantity. This juice in the majority of plants is, as has been said, colorless; it is, however, yellow in some, as in Celandine (*Chelidonium*); red in others, as in the Blood-root (*Sanguinaria*), the Bloody Dock (*Rumex sanguinea*), and the Logwood tree (*Hæmatoxylon*); deep orange in the Artichoke (*Cynara Scolymus*); white, as in the Spurges, the Dandelion (*Leontodon Taraxacum*), the Fig, the Poppy, &c. blue in the root of Pimpernell (*Pimpinella nigra*); and green in the Periwinkle (*Vinca*). The color is sometimes changed by exposure to the air. Thus opium, the proper juice of the Poppy, is white and milky when it exudes from the incision, but changes to a yellowish brown hue by exposure to the air. The juice which exudes from incisions in the leaves of the Soccotrine Aloe, yields, by simple exposure, according to the statement of M. Fabroni, a very deep and lively purple dye, so permanent, and resisting so completely the action of acids, alkalies, and oxygen gas, as to offer an useful pigment in miniature painting; or as a dye for silk, which it will effect without the use of any mordant.

The proper juice of plants is, *that changed state of the sap, after it has been exposed to the air and light, in the leaf, and is returning from it to form the different secretions.* The organs by which the secretion is performed are probably glands; and the secreted fluids themselves are deposited in cells in different parts of the plant, particularly in the bark, and the roots; these parts acquiring different medical virtues, from the matters thus lodged in them.

It is almost as impossible to obtain the proper juice of plants free from sap, as it is to procure the sap free from the proper juice; this, however, in the season in which it can be obtained in most abundance, is not so liable to be diluted or mixed with sap as at other times; and therefore it is in the warmest times in summer, that it ought to be taken for the purpose of examining its properties. In an accurate examination of the proper juice of plants, M. Chaptal found that in no two kinds of plants does it agree as far as its sensible qualities are considered; but as it is in the leaf that the change from sap into the proper juice occurs, so its sensible qualities are modified according to the action which takes place in that organ; and that this should differ is not surprising if we consider the great difference of the structure of leaves. In one particular, however, Chaptal found that all the specimens he examined agreed. When he poured into them oxygenated muriatic acid, a very considerable white precipitate fell down; which had the appearance of fine starch, when washed and dried, and did not change when kept for a length of time. It was insoluble in water, and not affected by alkalies. Two thirds of it were dissolved in heated alkohol; and these were evidently resinous, as they were again precipitated from the spirituous solvent by water. The third part, which continued insoluble in both alkohol and water,

was found to possess all the properties of the ligneous fibre. In the seed lobes a greater quantity of this woody fibre was found than in the proper juice of the plant itself; a fact which accounts for the rapid growth and increase of parts of the young plant, before the roots are able to take up from the earth the principles of nutriment. The proper juices of plants, both in the seed, and in the perfected plant, contain nourishment already properly adapted for assimilation into the substance of the plant. But this preparation takes place, either during the time, or after, the sap has been exposed to the action of the light and air in the leaf; as no woody fibre is found in the ascending sap, although the principles of it are undoubtedly contained in that fluid. A new chemical combination of these principles takes place; but how this is effected, or by what means the change is produced, we know not; and it is one of those mysteries of nature from which human ingenuity will never perhaps be able to remove the veil. In the same manner the blood of animals contains the components of the muscular fibres already formed; and an assimilation of it is constantly going on, without our being able to perceive it, or even to form the most distant conception of the manner in which it is performed.

The elementary principles of the proper juice of plants and of the sap are the same; but differ in the relative proportions. These elements are carbon, hydrogen, and oxygen. The same principles, differently modified, form all the secretions and the solid materials of the plant itself. The extraneous ingredients which some plants are found to contain, as part of their substance, such as the alkaline and neutral salts, metallic oxyds, silex, and other earths, are often probably obtained ready formed in the soil, in a state of division sufficiently minute

to be suspended in water, and taken in by the absorbent vessels of the roots. This is in some degree proved by the effect of change of situation on plants which naturally grow near the sea; for most of these, when burnt, yield soda; but, when they are removed from the sea-shore, and cultivated in an inland situation, potash instead of soda is procured from their ashes. Still, the siliceous epidermis of Grasses and Canes, and the flinty liquor sometimes found in the culms of the latter, can scarcely be produced in any other manner than by proper vegetable assimilation depositing silex from its unknown elements. As the sap undergoes the same exposure to the air and light in all plants, and one product only can be formed in each plant by this exposure, the difference of the proper juice in different plants, is a strong argument in favor of the existence of vegetable glands, independent of the undeniable proof afforded by the formation of the very different products which are deposited in different parts of the same plant. Unless there were glandular organs, one product only could be produced in each plant by the function of the leaves, and the action of light and of air on the sap. The secretions of plants formed from the proper juice are very numerous, and known under the names of *gum*, *fecula* or *starch*, *sugar*, *gluten*, *albumen*, *gelatin*, *caoutchouc* or *Indian rubber*, *wax*, *fixed oil*, *volatile oil*, *camphor*, *resin*, *gum resin*, *balsam*, *extract*, *tannin*, *acids*, *aroma*, the *bitter*, the *acrid*, and the *narcotic principles*, and *ligneous fibre*. These are found in different parts of plants without any uniformity of distribution; and although so numerous and different from each other in their sensible qualities and chemical properties, yet are they all composed of different modifications of the same elements, CARBON, HYDROGEN, and OXYGEN. Thus 100 parts of *gum*, according to the experiments of Gay Lussac and Thenard, consist of

42.23 of carbon,
6.93 of hydrogen, and
50.84 of oxygen, the oxygen and hydrogen being nearly in the same relative proportions as contained in water.

100.00

100 parts of common *resin* consist of

75.944 of carbon,
15.156 of a combination of oxygen and hydrogen in the same proportions as they exist in water, and
8.900 of hydrogen in excess.

100.00

100 parts of *olive oil* consist of

77.213 of carbon,
10.712 oxygen and hydrogen, as in water, and
12.075 of hydrogen in excess.

100.00

The solids, also, except the earths and salts, are formed, from the same principles. 100 parts of the ligneous fibre of the Beech and the Oak, for example, consist of

	Beech.	Oak.
Carbon	51.45	52.53
Oxygen	42.73	41 78
Hydrogen	5.82	5.69
	100.00	100.00

and thus almost the whole of vegetable matter may be resolved into these three simple elements.

Such are the general components of vegetables.

The investigation of which is yet only in its commencement, and much remains to be done before their real properties are well understood.

CHAPTER III.

THE ANATOMY OF STEMS.

The advocates for the natural method of classifying plants, distinguish them into two grand divisions, namely, the *Monocotyledones* and *Dicotyledones;* each of which displays a distinct internal system of organization, as well as the better known and more obvious distinctions of physical and botanical relations. In the plants of the first class (*Monocotyledones*) the stem simply consists of bundles of woody fibres and vessels, interspersed through a cellular substance, and decreasing in solidity from the circumference to the centre; but in those of the second, it is composed of concentric and divergent woody layers, decreasing in solidity in the opposite ratio, or from the centre to the circumference, and containing a pith in a central canal.

Another anatomical division, however, is requisite for the classification of the Acotyledonous and Agamous plants, such as the Ferns, Mosses, Algæ, and Fungi; whose stems display internally, an apparently homogenous mass, and when examined by the unassisted eye, seem to consist simply of an epidermis enclosing a parenchyma, composed either of cellular substance, of different degrees of succulency, sponginess, dryness, and density; or of interwoven fibres, forming a leathery, or felt-like texture, or one not a little resembling that of washed animal muscle, after maceration in spirits. When examined, however, by the aid of a good microscope, these different ap-

pearances of the internal mass are all found to consist of cellular substance, with vessels running through it, and anastomosing in a variety of directions. Many of these plants have no stem; but among those which possess it, in some it is solid, in others hollow; and in the latter case, the cavity is often partially lined with a very lax, dry, cellular web. A conspicuous root is rare; and, when it exists, consists of a few small radical fibres only. Scarcely any facts are yet known respecting the developement and growth of this description of stem.

Monocotyledonous Stems.

These are more complex in their structure than the preceding; being composed of two distinct parts, ligneous and cellular, which assuming a determinate character, enable these stems to be readily distinguished, even by the naked eye. They are either solid or tubular, and as there is some difference in the arrangement of the parts in these varieties, we shall examine them separately.

If a *solid* monocotyledonous stem, that of a Palm, for example, be cut, either longitudinally or transversely, it is seen to consist of an epidermis enclosing ligneous bundles or cords, more or less symmetrically distributed in a parenchyma or medullary substance. If the section be longitudinal, these ligneous cords are observed to run lengthwise, and extend from the base to the apex of the stem; sometimes in straight lines; but occasionally assuming a zigzag direction, so as to touch each other at different distances; closer together and firmer towards the circumference of the stem, and more apart and softer as they approach its centre. If the section be transverse, the divided extremities of the ligneous bundles appear like spots, which are

in some instances of a dark color, and in others white, dispersed over a white or a green ground, in the order just described. The epidermis adheres closely to the parenchyma beneath it; and in some plants of this class, the greater density of the cellular substance at the circumference gives the appearance of a bark, which is never, however, present in this description of stem. Such is the general character, and the distribution of the parts, in what may be termed the *ligneous* solid monocotyledonous stems; but when they have more of an herbaceous character, such, for example, as the scape of the great yellow Garlick (*Allium Moly*) and other species, there are no indurated ligneous cords; but the vessels run in the midst of longitudinal layers of condensed cellular matter, and in a transverse section appear as white dots forming a circle round the central cells, which are generally much larger than those of the circumference, and assume in some degree the aspect of a pith; so that in the longitudinal section, the diameter of the stem appears divided by two seemingly solid cords, into three nearly equal compartments.

Such are the appearances which, to the naked eye, or to the eye aided by a common lens, the solid monocotyledonous stems present. Under the microscope, we perceive that each ligneous cord is composed of very narrow oblong cells, and of vessels which are either spiral, annular, or porous, those in the centre being always spiral: that, in the cellular substance of the more solid stems, the cells are chiefly oblong, whilst in that of the herbaceous they form irregular hexagons, except towards the circumference, and in the immediate vicinity of the vascular cords; and that the membrane forming them is perforated with minute pores, surrounded by a glandular border.

The *hollow* or fistular monocotyledonous stems are composed of distinct portions, united by knots; at each of which the cavity is divided by a diaphragm; or rather, each portion may be regarded as a distinct individual, which takes its origin from one knot, and terminates in another, out of which again a new individual arises, and so on in succession. The general structure of this description of stems is best exemplified in the Grasses. Thus, in Wheat we perceive the upper articulation rising within the knot, in which the lower has terminated; with the leaf which infolds it crowning the embracing knot. The organization of this kind of stem cannot be readily distinguished without the aid of the microscope. It is seen, in a longitudinal section, to consist of several layers of narrow oblong cells, which constitute its exterior and more solid part; and of an interior more open cellular substance, enclosing vascular, ligneous cords, composed of oblong cells like those on the circumference, surrounding spiral and annular vessels. In the transverse section, the divided extremities of these cords appear as clustered vascular spots in the cellular substance.

The bark, if the surface of the stem can be so called, of the more solid monocotyledones, is formed of the footstalks of the leaves; but the real epidermis of both the ligneous and herbaceous stems of this tribe, is always, as has been already stated, so closely applied to the part which it covers, as to be inseparable from it by any means. Owing to this circumstance it appears of a cellular texture, and its character is regulated by the nature of the parts it immediately encloses. In those plants in which it can be readily examined, it displays, under the microscope, a regular series of organic exhaling pores, each apparently surrounded by a glandular border; as is well demon strated in culm of the Wheat: but in some plants, as,

for instance, the common Rush, these apertures are perceptible in the furrows only between the striæ, the elevations being apparently free from any exhaling pores. In some of the Canes and Grasses, as already remarked, silex is found deposited in, or rather immediately under the epidermis.

These kinds of stems, even when of the largest diameter, display no medullary rays, that being a character of the dicotyledonous class of plants; nor do such appear to be necessary, owing to the extensive distribution of the cellular matter throughout the substance of these stems. The woody bundles, however, become indurated by age, and the more external being enlarged by the deposition of new ligneous matter, they at length occasionally touch each other, and form a circle of continuous wood; but the interior bundles never attain this state, and so are always sufficient to distinguish the stem as that of a monocotyledon.

Stems of this class increase in length or height; but, with very few exceptions, not in diameter. The stem is gradually formed by the evolution and ascention of the terminal leaf-bud, and by the induration of the footstalks of the fallen leaves. The whole stem displays the cicatrices of the successive circles of detached leaves, and these, becoming hardened by exposure to the air, and the ligneous bundles within them being older, as they are nearer to the surface, the substance of the stem is necessarily softer within, and harder as it approaches the circumference. Owing to the mode of growth, also, which has just been described, the stem is always naked, columnar, and terminated with leaves and fruit in the form of a magnificent crown, as exemplified in the Palms. The *stipe*, therefore, or this kind of stem, may be regarded as a fasces of ligneous vascular rods imbedded in cellular

substance, and terminating in leaves; and its vitality being, in a great degree, dependent on the herbaceous part, if the central bud, or cabbage, as it is commonly called, be cut off, the whole plant immediately dies. The height to which some Palms arise, without increasing in diameter, is very remarkable. Thus the *Ptychosperma gracilis* rises more than 60 feet, with a stem not 4 inches in thickness. The elevation of the *Areca oleracea* (Betel-nut Palm) is often not less than 180 feet; and although its diameter is greater than that of the *Ptychosperma*, yet it is certain that it never increases in thickness. In tropical climates, some kinds of Ferns rise with a stipe resembling that of the Palms; but this appears to be, according to Mirbel, a simple fasces of petioles or leaf-stalks; although circumstances occasion these to unite in the interior of the stipe, and form masses of compact wood. This variety of stipe remains also of the same diameter.

The Aloes, Yucas, and the Dracæna differ in their mode of growth from the palms, inasmuch as they give off branches and increase in the diameter of their stems.

Such is the structure and mode of growth in monocotyledonous stems. The positive features which chiefly characterize them in point of structure, are the separate vascular ligneous cords, and intermixed cellular parenchyma; but they are distinguished more remarkably by negative qualities; as, for example, those of having no proper bark, liber, or alburnum, and no medullary rays; parts which belong exclusively to the dicotyledonous stems.

Dicotyledonous Stems.

Woody Dicotyledonous stems consist of 3 distinct parts, the *bark*, the *wood*, and the *pith*. They

are exemplified in trees and shrubs; but as the structure of the parts differs according to the age of the plant, it is requisite to examine them, both as they appear in the young plant or yearly shoot, and in the trunk and branches of older subjects.

If the *young shoot* of any tree or shrub, the Horse Chesnut for example, be cut either transversely or longitudinally, the parts which have been enumerated are rendered evident to the naked eye. If the section be transverse, it is seen to consist of a central spongy or cellular portion, which is the *pith*, enclosed within a ring of more solid consistence, which is the *wood*; and this, again, is environed by another circle of an intermediate degree of firmness, which is the *bark*.

The Bark. In the shoot we are now examining, cut in the autumn, the bark when separated from the wood is about the 16th part of an inch in thickness, and appears to the naked eye, composed of 4 distinct parts. 1. A dry, leathery, fawn-colored, semi-transparent, tough membrane, which is the *cuticle*; 2. a cellular layer which adheres, although not very firmly, to the cuticle, and is named the *cellular integument*; 3. a vascular layer; and 4. a whitish layer, apparently of a fibrous texture, which is the *inner bark*; and of a more complicated structure than the other layers.

1. The *Cuticle*. This term is employed to distinguish it from the thin unorganized pellicle already described under the name Epidermis, as one of the general components of the vegetable structure; and which is, in fact, the exterior part of the cuticle.

The cuticle may be raised from the cellular integument by the point of a knife, and this is the best

method to obtain it for minute examination. When thus separated and placed under the microscope, it appears to consist of 2 layers; the outer being the unorganized pellicle of true epidermis, and the inner a vascular texture, composed of minute vessels which terminate externally at the surface of the stem, and internally in the cellular integument. These are, apparently, annular vessels with oblong pores, which probably perform the office of exhalents or of absorbents. Such is the cuticular portion of the bark of the Horse Chesnut; but the structure of this part is not uniform in all the woody stems of this class. In that of the Pear (*Pyrus communis*), it consists rather of transverse cells than of vessels, the outer series of which is covered by the real epidermis: this is the case also in the lesser Periwinkle (*Vinca minor*), in which there are 3 series of such cells; in the Laburnum (*Cytisus Laburnum*), it is composed of the epidermis simply covering a layer of an irregularly cellular or spongy character. These and similar varieties in the structure of the cuticle account for the want of coincidence in the descriptions of authors.

The true epidermis or exterior layer of the cuticle is necessarily cribriform, whether it act as an exhaling or an absorbing surface; and the manner in which the pores are arranged, does not differ less, in different plants, than the structure of the interior layer. It is also frequently studded with hairs, glands, and prickles. In young and succulent shoots, the cuticle is generally almost colorless, and semi-transparent, transmitting the green color of the exterior part of the cellular integument over which it lies; but it becomes opaque or colored by age, or rather, on losing its vitality; for, as it is annually reproduced, the old layer, if it does not fall off, cracks and is pushed outwards by the increase of the diameter of the stem; and the accu-

mulation of such layers forms the rugged surfaces of stems, as we see in the Elm, the Oak, and the majority of trees. In the greater number of instances it cracks vertically, and is pushed outwards with a portion of the cellular integument by the new epidermis, which can be brought into view by removing these rugged portions. In others it splits horizontally, and the new cuticle is formed immediately under the old, which, after a time, detaches itself in fragments; or, there is a succession of cuticles, which, although one is formed every year, do not separate annually, but occasionally only, in multiplied layers, that can, however, be readily detached from each other, as in the the *Currant* and the *Paper Birch.*

2. The *Cellular integument.* On carefully raising the cuticle of the young shoot of the Horse Chesnut, we find under it a cellular layer; which, in a transverse section of the stem placed under the microscope, is seen to consist of two distinct parts, both cellular, but nevertheless different. The exterior, or that on which the cuticle immediately reposes, appears to be composed of a dark green, semi-organized pulp, in which the cells are irregular both in their dimensions and form, and has somewhat of the aspect, as Mr. Keith remarks, of "a distinct and separate epidermis in an incipient state, rather than a true and proper pulp;" while the interior is less colored and composed of regular hexagonal cells, the sides of which are perforated and frequently studded with small granular bodies. It is the exterior layer of the cellular integument, which is the seat of color in the young twig, and the green hue of which is transmitted through the yet semi-transparent cuticle; its appearance, and the fact that it is annually reproduced, led Mr. Keith to believe that it is really the next year's cuticle in an

incipient stage of organization. But the vertical direction of the cells, while those of the cuticle are horizontal, is sufficient to overturn this opinion. Mirbel regards the whole of the cellular integument as a glandular body serving to separate the transpirable matter from the other fluids. The cells vary considerably in form, according to the species of plant on which they are found. The cellular integument is filled both with colored and colorless secreted juices; and it is very probable that this part performs some changes on the sap thrown into its cells, similar to those effected in the leaf.

The cellular integument is partially destroyed and reproduced, a great part of the old portion being pushed outwards with the cuticle which is annually detached; while new cells are added to that which remains at the time the new cuticle is produced.

3. *Vascular layer.* Imbedded in the cellular integument and impinging on the internal surface of the bark, are distinct bundles of entire vessels, each of which is so arranged as to present, in the transverse section of the stem under consideration, a semilunar aspect; and, in the longitudinal section, that of a fascis of flexible cords, readily separable from each other, and from the surrounding cellular substance; which is condensed where it comes in contact with these bundles. These vessels are supposed to convey downwards the proper juice of the plant, elaborated from the sap, by the action of the light and air in the leaf; and this opinion is supported by the fact, that it is from them the milky juice of the Fig tree and the colored juices of other plants exude, when the stem is transversely divided. In some stems, as, for example, that of Laburnum, the vascular bundles coalesce, and form nearly one continuous layer or circle around

the wood; and in others, although they do not actually coalesce, yet they approach so close as almost to assume the same character. As the stem increases, these vascular bundles become impervious, and are pushed outward with the cellular integument, giving place to a new layer which is annually produced.

4. *Inner bark.* Immediately under the vascular bundles, we find another layer, which constitutes the internal boundary of the bark. In the transverse section of the stem of the Horse Chesnut it appears, under the microscope, to consist of the extremities of longitudinal fibres closely united together; and, in the tangental section, these fibres are seen running in a waving direction and touching each other at certain points, only so as to form oblong meshes, which are filled with cellular matter. This layer is denominated LIBER, a name imposed from its having been employed to write on before the invention of paper. As the net work formed by the dividing threads of the meshes is not readily dissolved in water, whilst the cellular matter which fills them up is remarkably soluble, the liber of some plants, for example the *Daphne Lagetto* (or Lace tree), when soaked in water and afterwards beaten, forms a very beautiful vegetable gauze; which may be used as an article of dress. A coarser specimen of this gauze, or lace, is seen in the bark of many of our indigenous trees, particularly the oak, when it has been long exposed to the weather, after being separated from the trunk. This regular arrangement, however, of the longitudinal texture of the liber is not found in every instance; for on the Fir and some other trees the longitudinal threads are seen lying nearly parallel to one another, without any meshes or intervening cellular matter. Like the other parts of the bark, the liber is annually reproduced.

The old layer loses its vitality, and is pushed outwards by the new; the accumulation thus formed constituting what botanical writers have called the cutical layers.

The vitality of the stem of dicotyledonous plants is more conspicuous in the liber than in any other part. If the bark be wounded, or a portion of it be removed, layers gradually extend themselves from the liber on each side of the wound until it is closed up; but as this is not effected in one year when the wound is extensive, and as the new layers are thrown out by the liber only, which is annually renewed, the cicatrice, if the healed portion can be so named, always resembles a hollow cone, the base of which is the exterior of the trunk. The union of a graft, or of a bud taken from one tree and implanted on another, succeeds only when the liber of the bud, or the graft, and that of the stock, is placed in immediate contact; the union in these instances closely resembling that which occurs when two raw surfaces of a living animal body, or of two distinct animals, are retained for some time in contact. Grew, Malpighi, Du Hamel, and others, supposed that the liber annually changes, by hardening, into the alburnum or young wood, an opinion also maintained by Mirbel and some of the ablest phytologists, but which is founded upon mistaken principles. It is through the liber, however, that the matter in which the new wood is formed, which annually augments the diameter of the trunk and branches, is secreted; and hence the importance of this portion of the bark.

Such is the structure of the bark of the stems of woody dicotyledons; and that of the roots does not materially differ from it; any difference depending, perhaps, altogether on the medium in which these two parts are situated. In the bark the secreted juices of

plants, and consequently their medicinal qualities, are chiefly deposited.

The Wood.—Pursuing our investigation in the young stem of the Horse Chesnut; when the whole of the bark is removed, we find, immediately under and slightly adhering to it, a firmer and more compact substance, which, both in a longitudinal and a transverse section, appears to constitute a cylinder, enclosing a column of spongy cellular matter or pith. This is the wood. It has been regarded, in reference to the vegetable, as answering the same end as bone in the animal body; but, except in its property of giving firmness and support to the plant, the analogy does not hold good. It is at first soft and vascular, and is then called *Alburnum;* but it afterwards becomes hard, and, in some trees, is of a density almost equal to that of iron. In a transverse section of our stem of Horse Chesnut, it appears, to the unassisted eye, a continuous circle of a homogenous structure, of a very light straw color exteriorly or near the bark, and greenish interiorly, or where it is in contact with the pith; but in some other trees, as the Laburnum and Elder, this circle appears traversed, at nearly regular distances, by rays of an evidently different structure. These are found, however, to exist also in the stem of the Horse Chesnut, and in every other woody dicotyledon when examined by a magnifying glass, and they are observed in the soft wood, or alburnum, as well as in the hard and most perfect wood. These two distinct parts, which constitute the wood, may be described under the names of *Concentric* and *Divergent* layers.

1. The *Concentric layers*, in the stem of the Horse Chesnut of one year's growth, when seen through the

microscope, consist of longitudinal fibres apparently not solid, but narrow tubes or oblong cells, the sides of which are thick and nearly opaque, and of vessels of different kinds. These are arranged parallel to each other, except where they are separated by the divergent layers, as may be seen in a thin tangental section of any stem placed under the microscope. In the *alburnum*, the walls of the concentric tubes are tender and transparent; but by the deposition of ligneous matter in the membrane of which they consist, and in the tubes themselves, they become opaque and firm; and according to the degree of this, the wood is more or less dense, hard, and tenaceous. Other matters, also, are deposited in this part of the woody texture; such for example as Guiac in that of the *Guiacum officinale*, coloring matter in the Logwood (*Hœmatoxylon Campechianum*), and even silex, which has been extracted from the Teak wood (*Tectonia grandis*) by Dr. Wollaston. The vessels of the concentric layers are chiefly porous and annular, and their sections produce the openings observed in the transverse section of any stem; but besides these, in the circle of the wood of the first year's growth, a circle of spiral vessels surrounds the pith. These are, however, justly regarded by Mirbel not as vessels of the wood; but of a distinct sheath lining the wood, which he has denominated *l'étui médullaire*.

2. The *Divergent layers* consist of flattened masses of cellular substance, which cross the concentric layers at different parts, and, separating the bundles of longitudinal tubes of which they consist from each other, produce the reticulated arrangement seen in the tangental section of any stem; the oblong tubes and vessels forming the tissue of the net-work, the meshes of which are filled up by the cells of the di-

vergent layers. The individual cells, which are narrow and horizontal in their length, extend in series from the centre to the circumference of the wood; and consequently form nearly right angles with the tubes of the concentric layers. They communicate with each other by pores; so that fluids may readily pass through the whole series, and of course transversely through the wood; and Mirbel remarks that, "in many coniferous trees the divergent rays are not cellular, but consist of horizontal tubes, which extend from the pith to the bark." Whether they are cellular or tubular, the layers, or masses, are flat, or in plates, with the edges placed vertically and thicker in the centre than either above or below, appearing therefore of a lozenge shape when vertically divided; whilst in their transverse section they display a slight inclination to the wedge form. They are much more delicate in their structure than the concentric layers; and readily dissolve, like the common cellular texture, so that when a thin tangental slice of wood is macerated in water, the divergent layers are decomposed, and leave the meshes of the concentric layers empty, displaying the appearance of a net-work or lace similar to that formed by the macerated liber. From the cellular texture of the divergent layers, they are regarded by some authors as processes of the pith; and hence have been named medullary rays; but many of them cannot be traced to the pith, although the more conspicuous of them traverse the whole of the wood, from the pith to the bark.

Wood, while in the state of *alburnum*, is endowed with nearly as much irritability as the liber, and performs functions of great importance in the vegetable system; but when hardened, these functions cease, and in time it loses even its vitality; not unfrequently decaying in the centre of the trunk of trees; which,

often, still flourish and put out new shoots as if no such decay existed. To carry on, therefore, the functions of the wood, a new circle of it is annually formed over the old; and thus, also, the diameter of the trunk and branches present, by the number of these annual zones, a pretty correct register of their age, each zone marking one year in the life of the part. The hardness of these zones of wood increases with the age of the tree, being most dense in the centre, and less and less hard as they approach the circumference.

Various opinions have been entertained respecting the origin of the wood or alburnum. Mr. Knight, however, by various experiments, has satisfactorily proved that the alburnum is formed from the secretion deposited by the vessels of the liber, but that it is not, as had been supposed by Du Hamel, Dr. Hope, and Mirbel, a transmutation of the liber itself.

Mr. Knight is of opinion, that the bark deposits the alburnous matter; but that the leaves are the organs in which this matter is elaborated from the sap; or, that the alburnum is generated from the *cambium* of Grew, which is part of the proper juice of the plant, formed by the exposure of the sap to the light and air in the leaf, and returned from it by the vessels that pass down from the leaf into the interior bark, by which it is deposited, and we may add elaborated by the action of the vital principle inherent in this part of the plant. To determine this point, he removed narrow circles of bark from shoots of Apple trees, "leaving a leaf between the places where the bark was taken off; and on examining them frequently during the autumn," he found that the diameter of the shoot between the insertion of the leaf-stalk and the lower incision was as much increased as in any other part of the tree; but when no leaf was left "on similar

portions of insulated bark, on other branches of the same age, no apparent increase in the size of the wood was discoverab'e."*

These experiments explain the reason why trees and shrubs having their leaves destroyed by caterpillars form scarcely any new wood in that season; and, indeed, every one who has ever pruned a tree, or shortened a growing twig, must have observed that the part above the last leaf always shrivels and dies, while all below it continues to live and increase in diameter.

The Medullary Sheath. If we proceed with the examination of the shoot of the Horse Chesnut, as before, and scoop out the pith from the ligenous cylinder that encloses it, we shall perceive that this is lined with a thin green layer or coating; which, to the unassisted eye, appears to resemble in its structure rather the cellular integument of the bark than any part of the surrounding wood. This is the *Medullary Sheath* of Mirbel and the French Botanists. It is readily distinguished, in either a transverse or a longitudinal section of many stems, by its green color, which appears deeper as contrasted with the dead white of the pith which it surrounds; but it is also easily traced in the succulent dicotyledonous stem as soon as it is evolved from the seed, separating the pith from its herbaceous investiture.

When viewed under the microscope, the Medullary Sheath appears to be composed of a cellular substance, in which are imbedded longitudinal layers of spiral tubes. The cells of the Medullary Sheath are narrow and oblong; and, therefore, when it is not colored, it is scarcely distinguishable from the wood,

* *Philos. Transact.* 1801. P. I. p. 2, p. 335.

except by the spiral vessels, which have not yet been discovered in any layer of formed wood subsequent to the first; for their apparent existence in stems and branches of several years' growth is owing to the lignification of the Medullary Sheath. The cells which are between the layer of spiral vessels and the pith, and which are the site of the coloring matter, when this part of the stem is green, have a cribriform structure. The variable arrangement which these spiral vessels present in different plants, appears to be in a great degree regulated by the disposition of the leaves, into which the spiral vessels in every instance direct their course, leaving for that purpose the Medullary Sheath, and traversing the wood, a little below the insertion of each leaf.

As the Medullary Sheath forms the only partition between the bark and the pith in the tender succulent shoots, before the ligneous matter is deposited, and is in its texture lax, and incapable of affording sufficient support to the delicate coats of vessels, such as are found in the Alburnum, if these were distended with ascending sap, the vessels that run through it are of a different structure from those of any other part of the vegetable. The elastic thread of which these spiral vessels are formed is tough, and possesses irritability; and being stimulated to action by the effort of the sap to dilate the diameter of the vessel, contracts in its length in each coil alternately, and after each contraction again returns to its first state, producing a vermicular motion, which enables these vessels to conduct forward the sap. Thus: the contraction in length of the portion of the thread which forms the first coil, lessens the diameter of that portion of the tube, and hence the fluid contained within it will be displaced and moved either upwards or downwards; but as the resistance opposed to its re-

turn, or movement downwards, is the greater owing to the pressure of the ascending sap, it must necessarily advance; and this contraction being repeated in every successive coil, the fluid is moved forward with a sufficient impetus; while the new quantity of sap which supplies the place of that carried forward, and which rushes into the coil at the instant of its relaxation, forming the basis of resistance to the return of the portion before it, and at the same time exciting a renewal of the contraction, its progression must be uninterrupted. These appear, indeed, to be the only vegetable vessels endowed with contractility, or which act in any manner analogous to the arteries of animals. If this hypothesis be tenable, the spiral vessels are the sap vessels of the succulent stem and the annual shoot of dicotyledonous ligneous plants; and their spiral structure is essential for the performance of their conducting function, in the spongy Medullary Sheath, or cellular parenchyma in which they are imbedded.

Malpighi regarded the spiral vessels as bronchia, or air-vessels, and the same opinion is supported by Grew, Hales, and Du Hamel. This supposition probably originated from their always appearing empty when examined; and on the same account the animal arteries were regarded as air-vessels by the ancients and their followers, until Harvey demonstrated them to be blood-vessels. Grew also suggested the idea of the spiral vessels acting as sap-vessels, and Du Hamel supposed he had detected them in the performance of this function, as did also the celebrated Hedwig. Dr. Darwin may perhaps, however, be regarded as actually the first who taught that the spiral vessels convey fluids.

The Medulla or Pith. Returning to our shoot of Horse Chesnut, we find the tube which is formed

by the wood and lined with the Medullary Sheath, filled with a white, dry, very compressible spongy substance :—this is the *Medulla* or *Pith*. In the succulent state of a stem or a twig, it is turgid with aqueous fluid ; but before the wood is perfected, it becomes dry and spongy ; except near the terminal bud, or where branches are given off, in which places it long retains its moisture.

The form of the pith is regulated by that of the cavity it fills, which in the majority of instances is nearly circular ; but to this there are many exceptions. Thus in the horizontal section of a young stem or twig of the Elder (*Sambucus*) and the Plane (*Platanus*), we find it circular, but furrowed by the bundles of the spiral vessels of the Medullary Sheath. It is oval in the Ivy, and the Ash ; irregularly oval and furrowed in the Plane ; triangular in the Oleander (*Nerium Oleander*) ; pentangular in the European Oak (*Quercus Robur*) ; four-sided, with the angles obtuse, or tetragonal, in the common Lilac, and yellow flowering Horse Chesnut (*Æsculus flava*) ; pentagonal in the Walnut (*Juglans regia*) ; and hexagonal in the Red-twigged Cornel (*Cornus sanguinea*). The situation of the leaves on the stem regulates the form of the tube which the pith fills. But besides the diversities of form which the pith presents, it varies in diameter in other respects. In the young tree, of a few inches in height, it is smallest at the basis of the stem, largest in the middle, and smaller again at the summit ; and in the growth of each future year, nearly the same variations in its diameter are observable.

The pith, in the majority of ligneous dicotyledons, is longitudinally entire ; but in some, the Walnut, for instance, it consists of a succession of transverse diaphragms intersecting the hollow cylinder of the wood, with the intervening spaces empty. In others the

continuity of the medullary column is broken by ligneous plates, which proceeding from the side of the central tube, either partially intersects it, or completely partition off portions of it, as in several of the Magnolias; while in others, again, it is merely a spongy sheath, lining the interior of the cavity, as in the stem and branches of Woodbine (*Lonicera Periclymenum*). Where the branches are given off from a stem, a thread of medulla, in some instances, separates from the central column, and entering the branch, is gradually augmented to a diameter proportionate to that of the branch. In the annual shoot, the wood shuts up the canal of the pith at its extremity, as soon as it ceases to grow for the season, as is seen in the longitudinal section of the shoot of Horse Chesnut, immediately under the terminal bud; and thus isolates it from the shoot of the next year. In many plants this forms a kind of woody partition, which marks the limit of the growth of each year in the length of the stem; but in others it is absorbed, the continuity of the pith being, apparently, uninterrupted from the root to the apex of such stems. Those partitions are almost always present when the pith is composed of distinct plates, as in the Walnut, or of a spongy sheathing membrane, as in Woodbine.

The color of the pith, in the succulent shoot or in the young plant, is green, which, as the cells empty, changes to white; but to this there are some exceptions. Thus it is yellow in the Barberry; pale brown in the Walnut; fawn-colored in the Sumach, (*Rhus Coriaria*); and pale orange in the yellow flowered Horse Chesnut; but it is more frequently colored in the caudex of the root than in the stem.

A vertical or horizontal section of a thin slice of pith, under the microscope, appears to consist of hexagonal cells, which are larger and more regular in the

centre than near the circumference. In very young stems and succulent shoots these cells are filled with an aqueous fluid, and closely resemble the cellular integument; but, in older stems and twigs, they are found empty, or more accurately speaking, filled with air. The cells retain the hexagonal form in their empty state; but in some, as in the Walnut, this is destroyed in the lamellæ, into which the pith then separates; and the same occurs in the interior of the medullary sheath of Woodbine, and similar hollow stems. In the greater number of plants no vessels are perceptible in the pith; but in some, entire vessels conveying proper juice are present, as in the Gum-elastic Fig tree, the proper juice of which is seen exuding from different points of the pith in a horizontal section of the stem: and in all plants, the cells communicate with each other by means of organized pores, which are visible under the microscope. The insulated and enclosed situation of the pith, whatever be the analogies of its structure, entitle it to be considered as a distinct organ in every stage of its existence.

Little is yet known with certainty concerning the functions of the pith. Dr. Darwin and Sir J. E. Smith considered it as important to the existence of the vegetable as the column of the spinal marrow in animals. Linnæus also regarded it as the seat of vital energy to the plant. But Mr. Knight found that on abstracting the pith from a portion of the branch of a growing Vine above and below a leaf and bud, "the lateral shoot, annexed, continued to live, and did not appear to suffer much inconvenience; but faded a litle when the sun shone strongly on them."* Indeed Cæsalpinius of the 16th. century, believed the

* *Philos. Trans.* 1801, p. 338.

pith to be less essential to the life and growth of a tree, than the bark. Mr. Thompson thinks its intention is to afford the necessary surface for the formation of the first layer of wood; and likewise that it is of use to give a degree of firmness to the succulent stem and recent shoot, which they would not otherwise possess, before the bark and alburnum acquire sufficient consistence for that purpose.

The original pith of the young shoot still remains in trees whose wood is of a close texture, as may be seen even in the centre of the oldest Oak, as it is defended by the first cylinder of wood deposited round it, and suffers no material compression by the successive layers. The cells, indeed, appear obliterated even when examined by a good lens, but in a very thin slice placed under the microscope, in a drop of pure water, the hexagonal character of the cells is perfectly distinguishable if the section be transverse; while, if longitudinal, not only the difference of form between the real pith cells and those of the medullary sheath is perceptible, but the spiral vessels are seen filled with a dark colored resinous matter. In such stems, therefore, the pith is neither compressed, obliterated, nor converted into wood, as some phytologists have imagined. But when the ligneous matter is of a loose texture, or instead of forming a continuous circle, it is in separate columns, as in broad-leaved Birth-wort (*Aristolochia Sipho*), and the divergent rays are very large, the pith, although it is never completely obliterated, yet, is considerably compressed and altered in form, in stems even of a few years' growth. The ultimate state of the pith, therefore varies; being regulated by the character of the wood which encloses it.

CHAPTER III.

THE ORIGIN AND ATTACHMENT OF BRANCHES.

Whether we regard branches merely as divisions and subdivisions of the stem, or more correctly, as regards their origin, as distinct individuals, its lateral progeny, we find their structure to accord, in every particular, with that of the stem. The description of the structure of the trunk is consequently applicable to the branches; and we have now, therefore, only to investigate the nature of the connexion between these parts; tracing the branch from its earliest state, or before it becomes visible to the naked eye, till it is fully extended, and has itself become the parent of future branches.

Every branch is formed in a bud or germ; and every bud, except perhaps the terminal one, and such as appear on roots, and constitue suckers, originates in the axil of a leaf; to trace, therefore, the origin of the branch, is, in fact, to trace that of the axillary bud; and this may be done most readily in the succulent shoot of any tree or shrub in early spring, as, for example, that of the common Lilac when just expanding its leaves.

In such shoot, in the axil of about the third pair of leaves, it is possible to perceive by the aid of the lens a minute elevation resembling a semi-transparent vesicle depressed in the centre; which under the microscope, appears to be a lobular body, with a small green speck in the central depression. This is the rudiment of the bud and germ, and consequently of the future branch. By strong magnifying powers we discover a connexion between the cellular matter of the lobes of this germ, and that of the pith, the medul-

lary sheath, the bark, and the liber, in the succulent shoot; while, yet, the germ itself appears a distinct body. As the bud advances in growth, it gradually assumes somewhat of a pyramidal form; and the organization of the germ, or new branch and leaves within it, commences. Towards the end of the summer, the lobes begin to appear as opposite scales, from amidst which the apex of the germ, covered by other scales, is observed protruding; whilst in a longitudinal section placed under the microscope, the rudiments of the new branch can be traced; for it is now obscurely marked by the deposition of alburnous matter, which being paler and more transparent than the rest of the bud, is seen separating the cellular substance to constitute the future pith from that which is to form the bark. But no spiral vessels are yet perceptible; the alburnous circle is mere semi-transparent matter; and the pith is distinguishable from the cellular substance in which the germ is formed only by the paler alburnous matter surrounding it. The progress of the organization advances a little in autumn; but is not perceptible during winter, and it is not until the following spring that the embryon branch is very conspicuous At this period, in the Lilac, for example, it is seen rising as it were from the medullary sheath, in which the spiral vessels seem to originate; and from whence, passing up, they distribute bundles to each of the leaves, which appear now completely organized, although extremely small and compressed within the scales of the bud. As the season advances, the bud lengthens; and at the moment of its opening, the young branch is seen projecting, clothed with its leaves, which gradually unfolding themselves, display in their axils the rudiments of future buds, destined to run the same course, and become in turn the parents of another series.

If the young branch be now dissected, it is found to possess exactly the same structure as the stem in in the early stage of its growth; that is, to consist of a central pith turgid with fluid, surrounded by the medullary sheath, around which the spiral vessels appear in distinct longitudinal bundles; and beyond them a layer of semi-organized alburnum, bounded by the liber; the vascular fasces of the bark are imbedded in the cellular integument, and the whole inclosed by the epidermis, which at this period is generally covered with excretory glands or some kind of pubescence. But after the leaves have expanded and performed their functions for some time, if the branch be again examined, by carrying a longitudinal section into the stem, we perceive its alburnum, now fully organized, and continuous with the new layer in the stem, deposited over that of the former year, which has already become wood; and, as the branch increases annually by new layers, in the same manner as the stem, a similar section made at any subsequent period displays its connexion with the stem, forming a cone, the apex of which touches the medullary sheath of the stem, and the base its surface whence the branch projects.

Such are the appearances which mark the origin of the branch and its connexion with the trunk, in the Lilac; and the same, with some modification, are perceptible in all ligneous dicotyledons.

We have seen that the rudiment of the bud is perceptible, in the axill of the leaf, on the young branch at the moment of its protrusion from the bud in early spring; and, that at this period, at least, it is an isolated body, distinct, as Gærtner has correctly asserted, from the proper and permanent members of the plant. The question thence occurs,—When and how are buds formed? Du Hamel supposed that they originate in what he terms pre-organized germs, which are de-

posited by the proper juice in its descent from the leaves, and pervade every part of the plant; but although it is impossible to demonstrate the fallacy of this opinion; yet, if it can be shown that buds, on whatever part of the stem or branch they are found, or at whatever period of the growth of these members they appear, can be traced to their origin in the first year's growth of the part on which they appear, it will be, at least, rendered improbable. To effect this, we have only to saw out a portion of any trunk or branch on which a young bud appears; and carrying the incision down to the pith, and by carefully slicing the portion horizontally, or in a right angle to the surface of the stem, till we divide the bud to its centre, we shall find a white line extending from it through every concentric layer of the wood, till it touches the medullary sheath. It is argued, however, that if an Oak, or any old tree, be cut down in winter, leaving the root in the ground, and a foot or two of the trunk, we shall find on the margin of the stump multitudes of buds protruding in the following spring. The fact is admitted, but not the conclusion inferred from it, that these buds originate on the surface where they appear; for, if they do not all push out on the same plane, which is the fact, there is no doubt that each could be traced to the centre of the trunk; as Mr. Thompson found to be the case in the Willow and some other soft wooded trees, which after being cut down, displayed the same appearances as the Oak, and the latter can hardly be imagined as an exception to the fact. If buds, therefore, be pre-organized germs, they can be deposited only in the first year's growth of the stem or branch, the admission of which would defeat the object of Du Hamel's hypothesis.

These facts, also, render less tenable the doctrine of Mr. Knight, that buds proceed from the alburnous ves-

sels, which he supposes have the power to generate central vessels: for, if this were the case, buds could be traced no deeper than the alburnum of the season in which they appear. Neither is the opinion strengthened by the fact, that if buds be destroyed in early spring, others appear; for, in this case, either the buds are such as have not been cut or rubbed off at a depth sufficient to extinguish their vitality, and prevent them from shooting forth again laterally; or, by destroying the already protruded buds, those that remain latent (two or more germs being often present in the same vital stream, if the expression may be allowed), receive a new impulse, sufficient to call into action their dormant powers, and enable them to protrude and evolve their leaves, in the same season; which, had the other buds been left, might not have happened for many years to come.

This fact is practically known to nurserymen and gardeners, who, without any theory, but guided by experience, act upon it in order to obtain a clean Cherry tree stem. No tree is so apt as this to throw out adventitious buds, but as this would deform and injure the plant, the nurserymen cut them off close to the bark. A second crop of shoots, very soon afterwards make their appearance, which are also taken away by the knife, after which no other appear; and, if the stem be now cut through under the existing branches, it ceases to grow. That the buds, when they first protrude, receive their nourishment from the descending proper juice, is extremely probable; but this would also be the case did they arise from the pre-organized germs of Du Hamel. If this reasoning be correct, part of our question is already answered, and we may conclude that all stem buds originate when the young stem is evolved from the seed, and all branch buds at the time that the young branch is

formed in the axil of the leaf. They are not, however, all protruded during the succulent state of the stem and branch, but many remain latent, performing so much of their functions only as is requisite to organize to their proper structure a certain portion of each successive annual layer of wood, and carry them forward in the embryon state; until circumstances occur favorable to the completion of their organization and protrusion on the surface of the stem; or until some accident destroys them, when instead of being carried forward they remain buried beneath the succeeding layers of the wood.

If buds be not pre-organized germs, nor formed from the descending proper juice, how then do they originate? In vital points, generated, in the first period of the growth of the stem and branch, in the axils of the leaves: or, that they are, to use the language of Darwin, distinct individuals, the lateral or viviparous progeny of the parent upon whose surface they appear. The individuality of buds must have been suspected as early as the discovery of the art of budding; and it is fully proved by the dissection of plants. The vital energy, however, which commences the process of organization in the bud, is not necessarily confined to the germ, nor distinct from that which maintains the growth of the entire plant; but it is so connected with organization, that when this has proceeded a certain length, the bud may be removed from the parent and attached to another, where it will become a branch the same as if it had not been removed; or, with proper care, it may be made to grow in the earth, and become an entire plant, with all the properties and external characters of the parent.

Before organization commences in the germ, it is, as we have seen, an insulated speck, covered by the epidermis only, and connected with the other parts of

the stem or branch, in which it is seated, merely by cellular matter. The effect of the organic power on it is the addition of new matter, and the consequent evolution of its parts; till gradually extending in the direction of its axis, it unites with and becomes a permanent part of the plant. The quantity of amylaceous granules contained in the cells surrounding the germ, renders it probable that it receives its first nourishment from this source; and it is not less probable, that the lobes which surrounded it, perform for it a similar function to that of the cotyledons, as connected with the embryon inclosed within them, or that of the leaves in reference to the stem and branch; which we shall afterwards prove to be analagous to that of the lungs in animals. But it is, also, probable that the leaf above the bud supplies part of the pabulum which is elaborated into the new branch; for, until its own leaves are expanded in spring, and capable of producing that change on the sap which converts it into proper juice, no alburnous matter can be formed by them. The descending juice, however, from the leaf above the germ, is not conveyed to it by any vascular communication, but deposited in the cellular mass or placenta, if it may be so termed, on which it is seated; and by which alone it is connected with the medullary sheath of the parent shoot. In the germ or vital speck, thus situated and supplied with nutriment, the organization of the branch commences as from a centre. It is not probable that we shall ever be able to trace every minute change, which occurs from this period until the first rudiment of the new branch is conspicuous, even by the aid of the best microscopes; but the first part that can be distinctly recognised is the pith, which, in a longitudinal section of the green twig of the Lilac, made three weeks after its protrusion from the bud, and the appearance of the germ on its

surface, resembles a more opaque spot of a greenish hue, with lines running in a direction from the centre of the parent branch towards the apex of the germ. These are the first traces of the spiral vessels of the future branch. The cellular matter, in the part of the bud above the vital speck, displays also at this period a more regular form, and indications of its separation into scales are already perceptible; but the whole bud is still a completely insulated body. As the organization proceeds, new scales are seen separating from the mass of parenchyma, the medulla enenlarges in every direction, and in autumn the whole presents a pyramidal appearance; in which state the bud remains nearly stationary until the ensuing spring.

As the cessation of the vegetative power in winter increases in a great degree the excitability of plants which outlive its severity, the genial influence of spring is very early visible on their buds, in which the whole vital energy of trees and shrubs may be supposed at this period to reside; and it is only by the visible change which rapidly occurs in them, that we can pronounce upon the life of the entire plant. If a longitudinal section of a twig be examined at this time, although the pith be, generally speaking, a dry, spongy mass, yet, a little above and below the parts where the buds appear, it is succulent and green. This can be explained only by supposing that the increased vital energy of the buds is extended around them to a certain degree, maintaining the lateral communication through the pores of the cells, while these have now become impervious in other parts; and by this effect a sufficient supply of nutriment is provided for the bud, which, enlarging in every direction as the spring advances at length, opens its scales and pushes forward, into the light and air, the young branch with its leaves and flowers. On examining now the connex-

ion of the shoot with the stem or branch, we find it no longer an isolated individual, but seated closely upon the medullary sheath of the parent, and the alburnous matter which is deposited between its bark and pith, continuous with that thrown out from the liber of the old bark, already giving origin to a ligneous layer, that forms both a connecting vinculum between the tree and the new branch, and a support to the latter in its projecting position.

A very clear idea of the origin and connexion of branches may be obtained by the aid of the diagram given and explained at the end of the volume.

Such are the observations which appeared necessary to illustrate the origin of branches and their connexion with the trunk; and from which the following conclusions may be drawn: 1. That every branch originates in a bud or germ. 2. That every bud or germ is a distinct isolated individual, the lateral progeny of the plant, and generated at the first developement of the stem or branch on which it appears, but, after some time, increasing by its own organic powers, it forms a branch, and becomes a part of the tree or shrub which has produced it. 3. That every adventitious bud, or bud appearing at any after period, originates in a germ generated at the developement of the stem or branch on which it appears, although it has hitherto remained latent. 4. That every latent germ is annually carried forward, in a horizontal direction, through every concentric zone of wood, intermediate to the medulla and the surface on which it will sprout into a branch; leaving behind it a substance of a peculiar structure, somewhat resembling a white cord, penetrating the ligneous zones, by which its progress can be traced. 5. That every branch when fully developed, displays the same structure as the stem.

CHAPTER V.

ANATOMY OF LEAVES.

The Leaf, physiologically speaking, may be defined to be a temporary organ of plants, which performs nearly the same function in the economy of vegetable life, as the lungs perform in that of the animal; or, in other words, leaves are the respiratory organs of plants. When these organs are absent as in the Dodder, and in the Cactus tribe, where their appearance, and that very inconspicuously, is only temporary, the green surface of the stem evidently performs the function of the leaves.

In the most cursory examination of the majority of leaves, we perceive that those organs are composed of three distinct parts: one part, firm and apparently ligneous, constitutes the frame work or skeleton of the leaf; another, succulent and pulpy, fills up the intermediate spaces of this frame work; and a third, thin and expanded, encloses the other two, or forms the covering for both surfaces of the leaf. On a closer examination we find that the first of these parts is *vascular*, the second *cellular*, and the third a transparent *cuticular pellicle*. Admitting, therefore, that these parts are present in every leaf, although we may not be able to discover all of them distinctly, owing to the imperfection of our instruments; we may conduct our inquiries into the structure of leaves in reference to their *vascular*, their *cellular*, and their *cuticular* systems.

I. OF THE VASCULAR SYSTEM OF LEAVES.

Among fallen leaves, which have been exposed to the action of the atmosphere in a damp place, or which have dropped into a pond, we generally find

some in which the cuticle and pulp are completely destroyed; whereas the ribs or veins, as they are commonly but erroneously termed, being less susceptible of decomposition, remain almost entire, and display the appearance of a beautiful tissue of net-work, more or less complicated. This is the vascular system of the organ, and the leaf in this state is termed a *skeleton leaf*. Leaves are frequently thus prepared by maceration in water, when the cuticle becomes easily separable by gentle rubbing and pressure; and the pulp may then be washed out from between the meshes of the vascular net-work by rinsing in water: and if the operation be carefully performed, the most minute cords of vessels may be preserved. These preparations enable us to trace more readily than in the natural leaf, the divisions, subdivisions, and various ramifications of the vascular fasciculi; but beyond this they afford us no information, and we must have recourse to the microscope to obtain a satisfactory knowledge of the vascular structure of leaves.

If we commence our investigation with the simplest description of plants, the Lichens and the Mushroom tribe (*Fungi*), for instance, we percieve, even by the assistance of the best glasses, scarcely any trace of a vascular structure, the whole plant appearing to be little more than an aggregation of cellular substance enclosed in a cuticle. This appearance, however, arises in some degree from the transparency of the vessels, preventing them from being distinguished from the cells, and in some degree from the simplieity of their structure; for, as the fluid they convey is not required to be raised to considerable heights, as in the more perfect plants, the conducting tube is consequently more simple. If, however, we take a plant in which the vessels convey a colorless fluid through a colored cellular structure, as, for example, *Mar-*

chantia polymorpha, we find that the surface of the lobes of the leaf-like frond, when examined by an ordinary lens, is reticulated by depressed lines, within each of which a small nipple-like body rises. When a thin slice of a lobe is placed under the microscope, these lines are discovered to be occasioned by vessels which run immediately under the cuticle, anastomosing with one another. This vascular net-work is formed by a single porous tube, branching and anastomosing so as to form irregular, lozenge-shaped meshes, which are filled with a dark-green cellular parenchyma. The vessel itself is closely connected with the cellular matter, and when separated, bears the marks of the cells on its sides. We find nearly the same vascular structure in the Mosses. The leaves of all the Mosses are sessile, although many of them are sheathing; and most of them are furnished with a midrib; but their minuteness prevents any certain information being obtained as to the manner in which the leaves receive their vessels from the stem, or whether there be a distinct set of returning vessels: they appear to be merely a continuation of the vessels of the cortex of the stem.

Proceeding to the next division of plants, those produced from *monocotyledonous seeds*, we observe the costæ or vascular fasciculi distinguishable by the naked eye; of different sizes, and running in gently curved or nearly straight lines, either from the base to the apex, or transverely from the midrib to the margin of the leaf. The former is found chiefly in those leaves which have no decided petiole, but spring directly from a bulb or a tuber; the latter in those which are petiolated. We shall examine each kind separately.

A bulb leaf of the White Lily (*Lilium candidum*), may be taken as an example of the general distribution and character of the vascular system in the first

description, the *sessile leaves* of monocotyledonous plants. On examining it, we find that the vascular frame work consists of a distinct midrib, which forms the keel of the leaf, and of less elevated ribs (*costæ*) that extend on each side of the midrib in longitudinal lines, which form a gentle curve, following the shape of the leaf. In the smoother and more succulent leaves of this division, however, these costæ are scarcely visible externally, or at least appear merely as striæ on the surface of the leaf: and this is the case, also, as far as regards many of the smaller vascular fasciculi, even in those leaves, which have prominent costæ. If we now make transverse and longitudinal sections of the Lily leaf, we perceive that the costæ are composed of fasciculi of spiral vessels closely accompanied with corresponding fasciculi of proper vessels, and imbedded in cellular substance: or, that the leaf has a double system of vessels, one for conducting forward the sap, and the other for returning the proper juice into which the sap has been changed by the functions of this organ. In the transverse section, these vascular bundles appear like dots upon the divided surface; and, when magnified in transmitted light, display their two-fold nature by difference of transparency; the part of each fasciculus composed of spiral vessels being particularly distinguished by a greater degree of opacity, owing to the spiral thread which composes the coats of these vessels being firmer and more opaque than the coats of the proper vessels. The spiral vessels of the leaf as well as those of the stem, are found generally empty, like the arteries of animals; while the proper or returning vessels are always full. In the majority of leaves the spiral vessels have a closer proximity to the upper than to the under disk. For, independent of the fact, that the chief function of these organs,

namely, the exposure of the sap to the light and air, would lead us, *à priori*, to conclude that the vessels carrying forward the sap must, necessarily, be on that side of the leaf most exposed to these agents; the sap-vessels receiving their origin in the stem from the vessels of the alburnum, and the returning vessels terminating in those of the bark, the disposition could not well be otherwise, seeing that the relative position of the upper and under disk of every leaf, to the centre of the stem, is exactly that of the alburnum and the bark. In leaves, however, which stand vertically, or have no distinction of surfaces, the situation of the spiral vessels is either the reverse, or in the centre of the entire vessels: anatomy thus confirming the idea of the close affinity of such leaves to stems.

It has already been stated that the bundles and threads of vessels, in leaves belonging to this division of the class under consideration, run in longitudinal lines. These are not exactly parallel, but approach both at the base and the apex of the leaf; and, also, communicate laterally in their course by small threads, given off at irregular intervals; as may be seen in a slice of the Lily leaf cut immediately within the cuticle of the upper disc, and placed beneath the microscope.

The vascular system, then, of the sessile leaves of monocotyledons, consists of fasciculi composed of spiral vessels, accompanied with proper vessels which are not spiral, arranged in longitudinal lines, and connected by smaller transverse threads; the whole forming a reticulated texture with irregular rhomboidal meshes. The longitudinal vessels are a continuation of those which are nearest to the surface, in the root, caudex, or the stem, from which the leaves immediately spring; and thus the greater number of the circles of the distinct fasciculi, which compose the stems of mo-

nocotyledons, terminate in leaves until the plant attains its ultimate growth.

There are two natural anatomical subdivisions of the *petiolated* leaves of monocotyledonous plants: namely, 1. Those in which the *ribs run longitudinally*, or in a direction from the base to the apex of the leaf; and 2. Those in which they run *almost transversely*, or in the direction from the midrib to the margin.

1. In this subdivion we perceive, that, in the Grasses, the vascular fasciculi resemble, very closely, those of the former division; the ribs being in longitudinal nearly parallel lines, converging towards the apex of the leaf; and united at irregular distances by obliquely transverse threads. If we take a stem leaf of Indian Corn (*Zea Mays*), as a specimen, we perceive the petiole, which is broad, expanded, and sheathing, deriving its origin from the whole circumference of the knot of the articulation which produces it; dilating gradually as it rises upwards, until its edges become a thin fimbriated membrane, and again contracting, but less gradually, at its upper part, or where it is united to the expansion of the leaf. The vascular bundles, which can be readily traced by the naked eye, are composed of two distinct kinds of vessels, which appear as dots in a transverse section of the petiole situated almost close to its external surface. The number of the spiral vessels in each fascicle is generally six, three large and three smaller, symmetrically arranged, as may be seen in a transverse section of one of the fasciculi viewed under the microscope; and the whole surrounded by a mass of much denser cellular matter than the rest of the substance of the petiole. The returning, or proper vessels are much smaller and more numerous than the spiral; and are aggregated into a bundle which occupies a space

close to the former, between it and the cuticle, and is bounded by a mass of the same dense cellular matter as that which surrounds the spiral vessels; the object of which is, probably, to give such a degree of firmness to the petiole, as will enable it to sustain, in the erect position, the expansion of the leaf. If we now make a vertical section of the petiole, so as to divide one of the fasciculi longitudinally, in the thickness of the petiole we perceive that the larger vessels are regular spirals, furnished with diaphragms at certain distances, the structure of which however, we shall perhaps never be able to ascertain, owing to the minuteness of the parts; the diameter of these vessels, although comparatively large, not exceeding $\frac{1}{300}$ of an inch. In this section, also, the proper vessels are membranous and porous; and the cells in immediate contact with both sets of vessels are oblong; whereas those which are between the proper vessels and the cuticle of the outer surface of the leaf, and which form the elevated portion of the costæ, although they are not oblong, yet differ both in size and in regularity of structure from those that form the inner substance of the petiole.

Ascending to the expansion of the leaf, which is separated from the petiole by a semitransparent white, condensed, membranous space from which the expansion of the leaf spreads out like a shoulder on each side: we perceive that the midrib, which is not distinguishable in the lower part of the petiole, becomes very conspicuous on the under disk at this point; forming almost a knob, which passes into a striated ridge, and extends, gradually diminishing in size, to the apex of the leaf. From 10 to 12 parallel costæ are visible on each side of the midrib, which, when magnified, appear like white parallel lines, running through the green smooth substance of the expansion, and taking

the curve of its shoulders as if originating in the white semitransparent space already described. But between these costæ there are several smaller vascular cords, which are scarcely visible on the surface, neither producing elevation nor difference of color ; and which can be demonstrated only on the dissection of the leaf. One of the more obvious distinctions, therefore, in the structure of the petiole and the expansion in the leaves of the gramineous tribe of plants is, that, in the petiole, the vessels run in distinct fasciculi, which are all nearly equal in point of size ; whereas in the expansion the fasciculi differ considerably in size, the larger only being very visible on the surface. In both, there are transverse threads which connect the longitudinal bundles, and those are conspicuous even to the naked eye in the more succulent leaves, particularly in those which involve the fructification of the Mays when viewed by transmitted light.

In examining a transverse section of a portion of the expansion of the leaf of Indian Corn, containing one of the visible costæ and the interval between it and the next costa, we immediately perceive the difference of structure in the two kinds of fasciculi. The visible costa consists of two large spiral vessels on the same line, and a compact fasciculus of proper vessels on each side of the line of spirals, towards both surfaces of the leaf ; while, in the interval, each fasciculus is composed of one small spiral vessel only, surrounded with a circle of proper vessels, and placed in the heart of the substance of the leaf. But, besides these, there is another kind of fasciculi, two of which are generally observed in each space between the visible costæ, connected with a peculiar cellular apparatus. These appear to be modifications of the two vascular fasciculi already noticed ; having the same structure as the obscure or invisible fasciculus, and

the accompanying compact bundle of proper vessels of the visible costa. In a section obtained by slicing the leaf, we find all these fasciculi united by transverse threads, forming rhomboidal meshes, similar to those which have been already described.

But although the arrangement of the vascular system of the leaf of Indian Corn, just described, may be taken as a specimen of that peculiar to the leaves of all the Grasses; and to those leaves of monocotyledonous plants which are petiolated, and furnished with longitudinal costæ, yet, there must necessarily be many modifications of this arrangement.

In the leaves of those monocotyledonous plants, the costæ of which, instead of being longitudinal, run in transverse parallel lines, forming acute angles with the midrib, we find that the arrangement of the vascular frame work resembles that of the Grasses in some circumstances; but differs from it in other respects. Thus the costæ are parallel to one another, and communicate by small transverse cords of vessels, so as to form meshes which are rhomboidal or square according to the angles at which these transverse cords are given off from the costæ, as in the Grasses. The petioles are, also, in general, sheathing, and many of them are furnished with ligulæ. But, in almost all of them, the peculiar cartilaginous articulation, which divides the petiole from the expansion in the Grasses, is not present; and the petiole assumes a stalk-like aspect before it reaches the expansion.

Taking the leaf of *Canna indica* (or Indian shot) as a specimen of the vascular system in this description of leaves, we perceive, on the under disk, that the midrib is much elevated near the base, and gradually diminishes in size, until it appears little more than a mere line at the apex of the leaf. The more elevated ribs are the primary vascular bundles or fas-

ciculi; and between these are secondary fasciculi, which are less elevated. To the unassisted eye they all appear to go off from the midrib; but viewed by a magnifying lens, and with transmitted light, we perceive that all of them do not proceed directly from the fasciculi of the midrib, but that some of them are branches of the others. At the margin they all inosculate, and form, as it were, one fasciculus, which, extending from the base to the apex, is the real living boundary of the leaf.

Examining more closely, and placing a slice of the petiole, cut transversely near the base of the expansion, under the microscope with a glass of a moderate power, we perceive that the vessels are arranged in distinct fasciculi, which are nearly of the same size in the centre of the section; alternately larger and smaller near the circumference on the convex surface, or that part of the petiole which is towards the under disk of the leaf; and all small on the concave surface. The costæ are continuations of those on the concave surface of the midrib, which are curved outwards in opposite pairs, at different distances between the basis and the apex of the leaf; but the central fasciculi pass on its apex. These vascular bundles are imbedded in a cellular tissue; besides which, the petiole and midrib of this description of leaves contain peculiar pneumatic or air cells closely resembling those which constitute a great part of the substance of aquatic plants. In a transverse section of a small part of the expansion of the leaf we perceive that the vascular cords run nearly in the centre between the two plates of cuticle, imbedded in an opaque green parenchyma; and that, instead of the pneumatic apparatus of the petiole and midrib, there is a transparent layer of large cells immediately under the cuticle of the upper disk. These pneumatic cells, however, are not

present in the petiole and midrib of all leaves with transverse costæ belonging to monocotyledonous plants, but the same general arrangement of the vascular cords, and, consequently, the same structure of the frame work, are seen in all of them.

The fasciculi in these, as in the other leaves we have examined, consist of spiral and proper vessels; differing, however, in the relative position of the spiral, which, here, in each fasciculus, are placed between two bundles of proper vessels.

Examining, by the same power of the microscope, a transverse section of one of the larger fasciculi of the midrib of the leaf of *Canna indica*, we find it to consist of one large, and from 3 to 6 smaller spiral vessels, arranged and relatively connected with the proper vessels in a manner closely resembling the arrangement of those in the fasciculi which are found in the stems of White Bryony.

From these remarks on the vascular system in the leaves of monocotyledonous plants, it is evident that a general character, however, variously modified in many instances, pervades the whole. The bundles of vessels are distinct; they run in directions parallel to one another; and the principal fasciculi are united by smaller transverse cords or bundles, which, form meshes of a rhomboidal figure, all nearly of the same size in the same leaf.

LEAVES OF DICOTYLEDONOUS PLANTS.

In these the reticulated structure of the vascular frame work is more complex and varied, than in the leaves of the two natural divisions, already examined. This is evident to the unassisted eye on holding up between it and the light any newly expanded leaf; but it is more beautifully demonstrated in the skeleton of a full-grown leaf, carefully prepared. We

shall now examine the modifications depending on two principal states of dicotyledonous leaves: namely, 1st. When the leaf is *thin* or *membranaceous:* and, 2d. When it is *thick* and *fleshy.*

1st. In the *thin leaves* of this class of plants, the vessels of the costæ proceed from the principal faciculus of the midrib, and run between the laminæ of cuticle, imbedded in the cellular matter, in cords which form visible elevations on the back of the leaf, and corresponding furrows on its face. Each fascicle consists of spiral and proper vessels throughout all its ramifications; and, in whatever manner these vessels are arranged in the fasciculi, the spiral and proper vessels are always associated, and, in general, tangent. This arrangement is common both to sessile and to petiolated, to simple and to compound leaves, as far, at least, as respects the expansion. In sessile leaves, however, all the fasciculi do not proceed from the midrib, but some are given off directly from the stem or the branch, and enter the expansion of the leaf at its base, on each side of the midrib. In petiolated leaves, also, the petiole is generally dilated at its point of union with the branch, and at this point the vessels enter the petiole in distinct bundles; the remains of which are visible in the scar produced by the falling of the leaves in autumn.

Thus in the Apple, the Pear, the Peach, and many other trees, the leaf is attached to the wood by three fasciculi, one of which enters the middle of the petiole, and the others, on each side of it. In the Laurustine the whole of the vessels pass from the wood into the petiole in one fascicle, the transverse section of which is nearly a complete semicircle. In compound leaves, the number of fasciculi passing into the petiole from the wood, is in some instances regulated

by the number of the leaflets; in the Elder, we find generally five; and in the Horse Chesnut, from 5 to 7 or 8. It is, however, the inner part only of these fasciculi, or that which conveys the sap to the leaf, that is given off from the wood, or rather from the medullary sheath; for the outer part, which consists of the proper or returning vessels, enters the bark, but not the wood. This fact is finely illustrated by placing young leafy twigs in colored fluids. The color is seen passing up from the stem into the leaf through the upper portion of each fascicle; while that part which consists of the returning vessels remains perfectly free from color.

Seen under the microscope, the following arrangement of vessels takes place in a thin transverse slice of the petiole of the Lilac, an example of a simple *petiolated* leaf. Close to the upper or channelled surface of the petiole, we find three small distinct fasciculi of spiral vessels, one immediately within the cutis, in the hollow of the channel, and one at each side; but the principal vessels constitute one large compound fasciculus, in the centre of the petiole, which appears of a horse-shoe shape, in the transverse section; and consists of one fasciculus of spiral vessels, and two fasciculi of proper vessels. The spiral vessels, which form the central fasciculus, are arranged in rays, which are sometimes tangent, at other times separate; whereas the proper vessels constituting the two fasciculi, one of which is situated within, and the other without the fasciculus of spirals, are irregularly imbedded in a pulpy parenchyma, and are readily distinguished by their greater transparency. The bark, or true cutis of the petiole, seems, also, to consist chiefly of several series of the same kind of proper or returning vessels. In the various modifications of this structure of the vascular system, in the petioles of

dicotyledonous leaves, the radiated arrangement of the spiral vessels is found in all: the petiole in this respect, as well as in the other parts of its structure, closely resembling the stem or the branch from which it springs. In simple leaves, with a few exceptions, although the vascular part forms at first several fasciculi, at the base of the petiole, yet these soon coalesce into one compound fasciculus; but in compound leaves they remain distinct. Thus, in the common kidney-bean, as an example of a composite leaf, in which the petiole is channelled, with an articulation at the base of the common petiole, and, also, at that of each partial petiole, we find that the vascular fasciculi are distinct, and form a circle situated immediately under the bark in the channelled parts of the petiole; with a considerable portion of lax cellular substance or medulla, inclosed within the circle which they form: whereas, in the articulated parts, there is one central fasciculus only, surrounded by a large mass of very firm cellular matter. The advantage of this change of disposition of the vascular bundles, in the articulations, is very obvious; for, had the fascicles remained distinct, and surrounding the pith, as in the articulations, those on the outside of the flexure, in every considerable motion of the joint, must have described so large a circle, as would have endangered the organization of the vessels by the extension; while those on the inner side would have suffered, equally, by the compression to which they must necessarily have been subjected. But, by the whole of the vessels being situated in the centre of the petiole, the extension and compression produced by the flexure in every part of the fascicle, is not more than can be borne by any individual vessel, whether spiral or entire; and, thence, the freest and most varied motion of the joint can be exercised with

impunity. The necessity of such a modification of structure, in the petioles of compound leaves, susceptible of motion, may indeed be inferred from the fact, that articulations are present in all those which perform certain movements; as, for example, those which fold together their leaflets at night; those which are endowed with the power of spontaneously moving their leaflets, as *Hedysarum gyrans;* and those which fold their leaflets together when touched, as *Mimosa sensitiva* and *pudica*, &c.

Some simple leaves, as those of the Hollyhock, of the Geranium tribe, &c. which have several principal costæ diverging from the summit of the petiole, and in this respect allied to digitate leaves, present nearly the same vascular structure of the petiole as the compound leaves. The fasciculi are distinct, and correspond in number to the principal costæ of the leaf; each of which may be thus regarded as a kind of midrib, and the leaf as composed of a number of conjoined leaflets; so that these leaves, although they are necessarily classed as simple leaves from their external appearance, yet, bear in anatomical structure the same affinity to digitate compound leaves, which the webbed foot of a bird bears to one which is not webbed. A similar structure, also, is found in the petioles of those leaves which are longitudinally ribbed, or nerved, as the common expression is, from the base of the expansion, as, for instance, those of the genus *Melastoma;* but, when the ribs do not originate from the base, although they are very conspicuous, as in the leaf of the Cinnamon tree, the structure of the vascular system of the petiole is exactly the same as in simple dicotyledonous leaves, which are not longitudinally ribbed.

If, instead of a transverse section, we place a longitudinal section of any of these leaves under the mi-

croscope, we perceive that each fasciculus is composed of spiral and proper vessels, the same which we have already seen to constitute the ribs in the leaves of monocotyledons.

Tracing the vascular fasciculi from the petiole into the expansion, in the thin, simple leaves, now under consideration, we find their divisions, subdivisions, and ultimate ramifications much more diversified and minute than in the leaves of monocotyledons. Whatever may be the origin of these divisions and subdivisions, whether they proceed from one central fasciculus, or from several longitudinal costæ, the ramifications become smaller and smaller, owing to a diminution of the number of the vessels which they contain; but not owing to any *diminution of the diameter* of the vessels themselves: for, although a principal fasciculus may contain larger and smaller spiral vessels, yet the general comparative magnitude of the vessels, in the smallest fasciculus, is the same as in the largest. A question therefore arises, whether the vessels of the leaf inosculate and anastomose, or are the smaller fasciculi merely separations from the larger?

Dr. Grew denied that they ever inosculate or anastomose until they arrive at their final distribution, and we find, indeed, this opinion so far correct, that the vascular fasciculi of the costæ, which are given off from the midrib, are separations from the petiolar fasciculi in their progress toward the apex of the leaf; and that the fasciculi forming some of the secondary costæ, also, are separated in a similar manner. But in the smaller ramifications, we perceive that many of the fasciculi are connected with each other at nearly right angles; and in these instances the vessels are not separations from the larger fasciculi; but are distinct, and merely applied in a peculiar manner to the sides of those from which they seem to arise; as can

be readily demonstrated by dissection, with the aid of the microscope.

Whether the communication of the cavities of these united vessels be direct, as in the vessels of animals, so as to allow the fluids they convey to flow in an uninterrupted stream from the one to the other, is not easy to determine. It is, however, evident that in the leaves of dicotyledons, as in those of monocotyledons, all the vascular ramifications of the foliar expansion are not prolongations of the vessels forming the petiolar fasciculi; but that many of them are distinct vessels anastomosing with others, although in a different manner from this kind of union as it occurs in vessels in animal bodies. It is probable that the inosculation which occurs in the proper or returning vessels, more nearly resembles that which we find in the vessels of animals; for, as the proper vessels are simple membranous tubes, any communication between them must be by direct openings, such as are found to exist in the vessels of *Marchantia.*

2d. The *thick* and *fleshy* leaves of dicotyledonous plants are seldom petiolated; but when they are so, the arrangement of the vascular fasciculi, both in the petiole and in the expansion, closely resembles that of the thin membranaceous leaves. The sessile leaves of this division are generally thicker and more succulent than the petiolated. If we take the genus *Mesembryanthemum*, as affording specimens illustrative of the character of these sessile leaves, we find that the vessels pass from the stem into the leaf in one or more fasciculi, according to the figures of the leaves. Thus in the Hatchet-leaved Mesembryanthemum (*M. dolabriforme*), the leaves of which are connate, the sap-vessels enter the leaf in one bundle, which extends in the direction of its axis, the whole length of the leaf,

giving off in its course a few thread-like branches only at considerable intervals; and as this vascular fasciculus and its ramifications are situated in what may be termed the pith of the leaf, and are, consequently, imperceptible on its surface, this description of leaves appears to the unassisted eye destitute of vessels. These organs are, indeed, comparatively few in succulent leaves, and are less necessary than in those which are membranaceous; for, as succulent leaves either exhale very little moisture, or absorb a considerable quantity from the atmosphere by their surfaces, the nutriment of the plant, in the first case, is sufficient, although the fluids taken up by the roots be comparatively scanty; and, in the second, it is supplied, independent of that which may be furnished by the roots, by cutaneous absorption. In the leaves of the broad-leaved species of Mesembryanthemum, and in similar succulent leaves, the vessels enter the leaf in several distinct fasciculi; which diverging, pass on in nearly straight lines, giving off a few bundles only in their course; but as they approach the apex of the leaf, whatever its form may be, they divide, subdivide, and inosculate as in thin leaves; and the proper or returning vessels accompany and surround the spirals in all their divisions. In the succulent leaves of dicotyledonous plants, also, we find the same system of tubular cells, between the pulp and the cuticle which exists in the Aloe of the monocotyledons; and in the Mesembryanthemum, under examination, we perceive these tubes commencing immediately under the cutis, and terminating generally in the cells of the central pulp; but sometimes in follicles, which are both very irregular in form, and of very different dimensions. It is probable that part of the fluid taken up from the atmosphere passes at once into the central cells, the contents of which are colorless, while

another part remains in the tubular cells, and undergoes that change, which is the usual result of the agency of light on the juices of all leaves exposed to its influence. The green color of the fluids contained in these cells, marks out their limits, in a transverse section of the leaf, even to the naked eye.

The structure of the vessels in succulent dicotyledonous leaves is the same as in all other leaves. The conducting vessels are spiral tubes, of the same diameter at the apex as at the base of the leaf; and the proper or returning vessels are membranous, and apparently perforated, although their transparency renders it difficult to determine their real character. The ramifications are all given off at acute angles; and appear to be merely separations from the caulinar or petiolar cluster, as Grew supposed to be the case in all leaves; at least they do not anastomose until, as I have already stated, they approach the apex of the leaf.

II. THE CELLULAR SYSTEM OF THE LEAF.

On cutting a thick, succulent leaf transversely, we immediately perceive that it consists chiefly of a pulp, which, when placed under the microscope, or examined by a good magnifying glass, is evidently composed of cellular tissue; and indeed we find that this substance forms a large part of the structure of leaves; filling up the meshes of the net-work formed by the vessels in the thin and very vascular leaves; and, in all, occupying that space which separates the two cuticular layers, which constitute the upper and the under disks of the leaf.

The cellular substance of leaves differs very considerably in *density:* but this diversity depends more on the quantity and quality of the juices the cells contain, than on any diversity of structure in the cells. To

the same causes, also, may be attributed, in a great degree, the *variety of figure* which these cells exhibit; for, although they are in some instances globular, or nearly so; and in others triangular, or more or less regularly hexagonal; yet, it is probable, that the majority are originally spheroidal vesicles; and that the variations from this figure depend on the turgescence of the vesicles, and the consequent compression which must necessarily result from their contiguity. The hexagonal figure being that which spheroidal vesicles, mutually compressing one another, are naturally disposed to assume, we find that a more or less regular hexagon is the most common form of these cells; and this figure is generally more regular in the cells forming the centre of the substance of the leaf, owing to these being there more distended with fluid, than in those towards either of the cuticles.

But that the diversity of figure in the cells of leaves does not, altogether, depend on mechanical compression, is evident from the fact, that those towards the upper disk of the leaf often differ in form from those towards the under disk; and yet in both these situations we may suppose the compression to be nearly equal. This difference is probably necessary for the distinct functions of these two surfaces. When the tubular cells of leaves are cut transversely, they appear to be of an hexagonal figure, and not round, as might be suspected from their longitudinal aspect.

With regard to the individual structure of the cells constituting the parenchyma of leaves, we find it is the same as that of the cells in the other parts of the plant. Each cell appears to be a distinct, transparent, membraneous vesicle, formed into the figure it displays by the pressure of the contiguous cells, and thence, the partition separating each cell, must be a double membrane. This is more evident in the mi-

croscopic examination of the cellular substance of some leaves than of others; thus, in a minute portion taken from the leaf of *Iris germanica* (a common garden species), we perceive that not only the cut edges of the cells appear double; but that where some of the cells deviate from the hexagonal figure, there are evident interstitial spaces between them, which, if the cells were not distinct vesicles, would not occur.

A question arises in consequence of the supposition that each vesicle is a distinct sac:—in what manner do the cells communicate with each other, and with the vessels which they surround? Malpighi maintained that a small tubular production issues from each cell or vescicle, by which it communicates with the contiguous cells, and with the vascular system of the leaf. A similar idea was entertained, also, by M. de Saussure. Mr. A. T. Thompson, however, was unable to detect those communications. Even in that peculiar modification of the cellular structure, which is found immediately within the cutis of the inferior disk of some leaves; and in which the cells assume the appearance of anastomosing tubes, none of the tubular connecting processes, described by Malpighi, are perceptible; nor do these cells appear to communicate directly with the vessels which they surround. It may be asked then, in what manner do the cells communicate? To answer this question, we ought to understand the structure of the intercellular membrane. But here our instruments fail, if they do not mislead us; and, under glasses of the highest power, this membrane appears different under different circumstances; by transmitted light, it seems a simple, unorganized, transparent pellicle; but, by reflected light, is evidently porous. As the cells of the stem appear to communicate by pores, so may also those of the leaf. An opinion has been advan-

ed, that the fluids may be transmitted from cell to cell, even when imperforate, by the exercise of the alternate functions of secretion and absorption; but these functions imply the existence of either glands or vessels, connected with the absorbing and secreting surface, which are, however, even less demonstrable than the pores. Upon the whole, the question still remains unanswered; and all that we certainly know of the subject is, that the fluids are transmitted from cell to cell, through every part of the vegetable system, although the structure by which this is accomplished remains undiscovered.

Whatever may be the mode in which the cells communicate with one another, their contents are more or less fluid or solid, according to their situation in the thickness of the leaf. Thus, in thin leaves, the cells near the inferior disk are more transparent, owing to their contents being more fluid than those near the upper disk; but in both we perceive a number of granules, which are more opaque and of a deeper green, as the cells containing them approach the upper disk. In succulent leaves, and those which maintain a vertical position, the opacity and green color of the granules, are the same towards every face of the leaf; but they are generally colorless in its centre. In the cells, also, of some leaves, regular crystallized salts are found; and in others the fluids are tinged of different hues besides green; in which case the leaves themselves display the same hues on one or both surfaces.

The *size* of the cells varies in different leaves; in some, even when examined under the most powerful glasses, they appear like the smallest vesicles; while, in others, they are so large as to be perceptible to the unassisted eye.

From these inquiries into the structure of the *vas-*

cular and *cellular* systems of leaves, the affinity which exists between the stem and the leaf is very obvious. In the stems of monocotyledons, the vessels run nearly in straight lines in distinct fasciculi, imbedded in a cellular pulp; and a similar vascular arrangement presents itself in the leaves of this tribe of plants. In dicotyledons, on the other hand, the vascular fasciculi of the stem are not distinct, but form a reticular tissue which covers the whole circle of the stem; and, in like manner, in the leaves, the vessels ramify in every direction, forming a most complicated and beautiful net-work, the interstices of which are filled with the cellular pulp. The leaf, therefore, may be regarded, in some respects, as a mere expansion of the stem; and, consequently, in aphyllous plants, we perceive that the stem is adapted to perform all the functions of the leaf. The internal structure of the floral leaves or *bracteæ*, and of those more temporary foliar appendages, which are termed *stipulæ*, is nearly the same as that of the real leaf; even the scales that envelope buds (sometimes indeed true stipules), and described as deriving their origin from the cortical part only of the stem, and consisting chiefly of cellular matter, have in every respect the same structure as leaves, as far, at least, as relates to their vascular and cellular systems.

THE CUTICULAR SYSTEM OF LEAVES.

Every leaf is covered with a real skin or epidermis, which not only guards the vascular and the cellular matter from external injury; but is the medium by which it performs the important functions of absorption and exhalation. In the majority of leaves, the epidermis can be separated from the parts it covers; and appears to be a compound organ, or to

consist of two distinct layers; the exterior of which is a fine, transparent, apparently unorganized pellicle, and the interior vascular and cellular.

The true epidermis, or the delicate pellicle which forms the outermost covering of the leaf, is described by Saussure as being perforated by the slits or pores which may be found on one or both of the surfaces of every leaf; but on minute examination it appears, that it is not perforated by them, but enters into them, as well as into every gland opening on the surface of a leaf, as a lining membrane; and is, in fact, the covering of every part of the vegetable texture, which would otherwise come in contact with the air. If, however, it cover every part of the surface of the leaf, and is an imperforated membrane, by what means, it may be asked, does the fluid which exhales so freely from the leaves escape? It is not easy to answer this question; but as we can scarcely form an idea of a membrane perfectly free from pores, even in a living body, transmitting fluids; we may conclude that, although no pores are visible in this membrane, even when it is examined under the microscope, yet, it does not follow that no pores exist; and, in accounting for the transudation of the fluids, which the leaf throws off, we must always bear in mind, that the functions of living bodies are influenced by different powers from those which regulate the operations connected with inert matter.

The second or *interior cuticular* layer is seen through the epidermis, and consists of a vascular network resting upon a layer or layers of cells. The *lines* forming the meshes which characterize the cutis of leaves, were first described by Hedwig as vessels, originating in the circumference of the pores; an opinion supported by the elder Saussure and M. Kieser; and which is confirmed by the microscopical ex-

amination of a portion of the cutis of any leaf. Admitting these lines to be lymphatic vessels, it is not improbable, as Kieser has asserted, that they terminate by one extremity in the larger vascular fasciculi. The meshes which they form, differ very much, both in form and size, in different leaves. In almost all the monocotyledons, in the Grasses, and in every plant the leaves of which have parallel costæ, the meshes are nearly irregular parellograms; but, in forming these, the vessels sometimes run in straight lines, as in common Meadow Grass (*Poa trivialis*); sometimes in slightly undulated lines, as in the White Lily; and sometimes zigzag, as in Indian Corn. In some of the fleshy leaves they are nearly regular hexagons, as on the upper disk of *Hoya carnosa*, and on both surfaces of the leaves of *Aloe verrucosa:* but, in the majority of dicotyledons, they assume very irregular figures. Whatever may be the fissures which they present in the cutis covering the spaces between the vascular ramifications of the leaf, they invariably appear as irregular parallelograms in that which covers the vascular fasciculi; a fact which gives some support to the opinion of Kieser, that the vessels forming the meshes terminate in these fasciculi. The difference in the size of the meshes, in different leaves, is still more striking than in their forms; but in all they are very minute. On a portion of the cutis of *Aloe verrucosa*, $\frac{1}{576}$ of a square inch in size, Mr. Thompson counted 96 meshes, or 55 $\frac{296}{1000}$ to the square inch!

The form of the *cuticular cells*, owing to the cutis being more transparent than the epidermis which covers it, can be demonstrated only as they appear in a vertical section. They are either spheroidal or oval; and are found generally empty, or filled with a colorless fluid. In the greater number of leaves the cutis contains one layer only of cells; but it may contain sev-

eral, as Mr. Francis Bauer has demonstrated in the genus *Hæmanthus*, and others.

The *slits* or *apertures* already noticed as existing on one or both surfaces of all leaves, were first described by Grew as orifices; and the observations of Hedwig and of Decandolle have confirmed this opinion, and under a good microscope it is easy to perceive that they are real pores. In the leaves of trees, and of some other plants, they are observed on the inferior disk only; but in others, particularly in the Grasses, the Lilies, and the Palms, they occupy both surfaces. They exist also in the lower tribes of plants, as may be perceived in *Marchantia*, and a few of the Mosses. Plants which have no leaves, as the Cactus tribe, and many of the Rushes, and some of those, also, which have leaves, as the Grasses, have pores on the stem; but, in general, they are confined to the leaves. The leaves of aquatic plants, however, which are constantly under water, are destitute of pores; the upper disk only of leaves which float on the surface of water, possess them; and when a land plant is made to grow under water, the new leaves, evolved under the water, have no pores, although those which they have succeeded, or the aërial leaves, were furnished with them. Even in plants which are partly immersed and partly submersed, as *Ranunculus aquatilis*, the leaves growing under water are destitute of pores, while those which float above are provided with them.

These foliar apertures vary very considerably in *form*, *size*, *number*, and *position*, in different leaves. They are commonly oblong, but in some instances circular, and in the Agave tribe and a few other families of plants, they are quadrilateral. In almost all leaves they are surrounded by a border, in which the vessels forming the cuticular meshes appear to ter-

minate. Placing minute portions of the cuticle of different leaves under the microscope, we can readily ascertain the superficial form of these pores. Among the varieties of the annulated aperture, we sometimes find the space between the pore, or the shield and the inclosing ring, divided into distinct portions; and occasionally a double ring, with the intervening space, also, divided into four or more equal parts: examples of the first variety are found on the lower disk of the leaves of Lilac, *Aucuba japonica*, *Hoya carnosa;* and on the upper side of the leaf of the French Sorrel (*Rumex acetosa*). The upper disk of the leaves of the Sweet-scented Violet (*Viola odorata*) affords a good example of the double ring. But a very remarkable form of the cuticular pore is observable on the back of the leaves of the Oleander. It appears, on a superficial view, a simple oval aperture without any shield, but guarded by hairs which cross it in different directions; and is comparatively much larger than any of the other kinds of pores.

The *size* of these pores are so small in the Myrtle, Rose, Leguminous and Pink families, that 200 of them, at least, might lie upon a geometrical line.

In *number* the foliar apertures vary, also, in different plants. The more minute they are, the more numerous. On the lower surface of the leaf of *Gardenia latifolia*, we find an aperture in almost every mesh; but in the Aloe tribe scarcely one pore for 20 meshes, and on the leaf of Oleander, one among 60. With regard to *position*, these apertures are in some instances arranged in lines from the base to the apex of the leaf, and have the same direction throughout; but in the majority of leaves they have no regular arrangement, and assume different directions. In herbaceous plants we generally find them on both surfaces of the leaves; but in ligneous plants they are scarcely ever seen on

the upper surface. They are never situated on the costæ, nor on the edges of the leaf.

But these demonstrations make us acquainted with the superficial aspect only of the foliar apertures; placing under the microscope a very thin vertical slice of a leaf of the Clove Pink (*Dianthus caryophyllus*), cut in the direction of the axis of the leaf, we find that the aperture which is thus divided in its longitudinal diameter, is a short cylindrical tube penetrating completely through the cutis, and terminating in a sac, which is impressed with a vesicle that appears to communicate with the oblong cells immediately beneath the cutis. But although the aperture penetrates the cutis, there is no opening through the epidermis, which, on the contrary, enters into the tubular part of the pore, and lines it throughout. In another slice of the same leaf, cut so as to divide one of the apertures in its cross diameter, we may perceive that the vesicle appears to be double; from which it is probable that it is this vesicle, seen through the transparent substance of the cutis, which gives the appearance of the shield in the superficial view of the aperture. As we find that, in the superficial view of these apertures, the character varies considerably in different plants, so this form of the tube and the vesicle is also variously modified; but the general character is nearly the same, with a very few exceptions, throughout the vegetable kingdom.

Decandolle considers that the cuticular apertures are connected with the ultimate ramifications of the vessels of the leaf; and, if it be true, that the cuticular meshes are formed by lymphatic vessels, which terminate on one hand in the larger vessels of the leaf, and on the other, in the vescicular circles surrounding the fundus of the aperture, this opinion must be correct.

From what we are able to learn concerning the structure of these pores, there is reason to believe that they are the respiratory organs of plants; though phytologists have considered them as intended for the functions of *absorption* and *exhalation.* The idea that they are *absorbing* organs, is supposed to gain support from the circumstance, that leaves absorb more powerfully with their lower than with their upper surface: but although leaves absorb chiefly by their inferior surface, yet, this does not prove that these apertures are the absorbing organs; for we find none of them on the lower side of the leaves of *Nymphæa* (the Water Lily) and other aquatics, which have floating leaves; although these leaves absorb powerfully by their lower surface, and exhale by their upper, which is covered by these apertures. It is still more difficult to accord with the opinion, that the same foliar apertures perform such opposite functions as those of *absorption* and *exhalation;* although there is nothing incongruous in supposing that they are both exhalent and respiratory organs. That they exhale, was first rendered probable by the experiments of Treviranus, who found that plates of glass applied to the lower disks of leaves were soon covered with drops of water, while they were not at all bedewed when they were affixed to the upper disks; and Decandolle proved that the aqueous transpiration is greatest in those plants which are supplied with the greatest number of apertures. To prove that these apertures are the foliar exhalents, and that no exhalation takes place when they are obstructed, Mr. Thompson made the following experiment with two twigs of *Laurustine,* each having 4 leaves nearly of the same size, and brought to the same weight in opposite scales. The lower disks of all the leaves on one twig were next brushed over with a composition of mucilage of

gum-arabic and a small proportion of tragacanth; and when this was dry, each twig was placed under a cylindrical jar containing air, and immersed in a saucer of water. In a short time the sides of the jar containing the twig in its natural state, were covered with drops of water; but, at the end of two days, not the smallest quantity of moisture appeared on the sides of the jar containing the twig, the apertures of the leaves of which had been obstructed by the mucilage. The conclusion therefore is, from this experiment, that that surface only on which apertures exist exhales, and consequently that these apertures are the exhaling organs.

All animals that require the presence of air for their existence, have some peculiar apparatus for producing that change in the blood which has been termed its oxygenizement; and the change is said to be the result of respiration, whether it be performed by lungs or by spiracula. Plants, also, require the presence of air; vitiating it, under certain circumstances, in the same manner as animals, but, under others, increasing the proportion of its oxygen: hence plants may properly be said to respire, and the question arises, by what organs is this function performed? Phytologists have generally agreed, that the leaves are the lungs of plants, but in what part of it are the respiratory organs situated? The foliar apertures appear to be the actual breathing organs of the plant. In support of which position it may be advanced, that these apertures are never seen on leaves that are not exposed to the air; for the leaves of submersed aquatics are devoid of them; even the leaves of plants which are not naturally aquatic, if kept submersed, soon lose them; and although some plants of the higher classes, which grow in the air, have no leaves, yet, these have apertures on the stem, which, in such instances, per-

form the respiratory function. But the most perfect plants are furnished with leaves, which, being membraneous and peculiarly attached, are moveable in the air, where a perpetual supply of that fluid is constantly presented to their breathing apertures; this mobility of the leaf supplying, in some degree, the motion of the thorax and the diaphragm in the more perfect animals. The plants which have very thick and immoveable leaves, on the contrary, or which are devoid of leaves, as they resemble the cold-blooded and slow-moving animals in their tenacity of life, like them, also, require a smaller supply of air, and consequently, as we have already seen, are less amply supplied with breathing apertures. In structure these organs seem well adapted for the purposes of vegetable respiration, when we consider that the changes effected by this function in the sap of vegetables in the leaf are not required to be so quickly produced as those in the blood of animals; even of insects of the lowest description. The air is admitted through the funnel-shaped pore, which perforates the cutis, into a vesicle situated under it; and which probably communicates with the cuticular cells, as these are, in general, found filled with air. The aqueous contents of the cells that form the parenchyma of the leaf, are thus brought into immediate contact with the atmosphere. It is not easy to assign a reason why these apertures are found on the under disk only of the leaves of trees, while they appear on both disks of herbaceous leaves; there being lymphatics on both disks in the former as well as of the latter description of leaves. If any connexion could be traced between the returning vessels and the apertures, the difficulty would be diminished, the situation of these vessels being on the lower disk of the leaves of trees.

With regard to the origin of these apertures, Saus-

sure's and Kieser's observations would lead us to believe that they are merely the terminations of numerous vascular processes from the larger fasciculi ; which, gradually penetrating the cuticle, are thus enabled to discharge their fluids. This opinion, however, is altogether hypothetical. They are so far essential that they are found on every leaf in contact with the atmosphere ; their structure, position, and situation, are the same on the leaves of every plant of the same species ; and their existence seems to be influenced by no conditional circumstance except the presence of air. With regard to the fact, they are not found on submersed leaves, even of land plants which are made to grow in the water, we may observe, that the leaves produced on such plants differ from those which are natural to them, not in the absence of apertures only, but in form, structure, and functions.

The knowledge of the structure of leaves enables us to form a correct idea of the importance of these organs in the economy of plants. We find the vessels which convey the *sap* from the roots terminating in the leaf, and spreading out their contents through its cells, to undergo certain chemical changes which are essentially influenced by the action of the air and light ; we find, also, a new system of vessels commencing here, which take up again the sap thus converted into *proper juice* and conduct it downwards, depositing in their course the various secretions formed from it, either in the stems or in the roots, as the nature of the plant requires ; and, in aid of these operations, a cuticular system admirably adapted by its transparency to transmit the rays of light into the foliar cells, and by its organic apertures to admit the air, and at the same time favor the exhalation of the superabundant water, which the ascending sap necessarily contains. But, besides fitting the sap for yield-

ing the secretions found in the bark, wood, and roots of plants, the leaf itself is a secerning organ, and contains in its cells and follicles many secretions useful, undoubtedly to the plant itself; but, independent of that, of the first importance in medicine and the arts; and in supplying food for the support of animal life.

GLOSSARY

OF

BOTANICAL TERMS.

Abortive. Producing no fruit.

Abrupt. Terminating suddenly, as if cut off; as in the root of *Sanguinaria Canadensis.*

Abruptly pinnate. Pinnate with even pairs only. Wanting the odd or terminal leafet.

Acerose. Stiff, linear, and sharp, as in the leaves of the Pines.

Acicular. Needle shaped.

Acinaciform. Shaped like a scimetar. Linear, crooked, and sharp edged.

Acinus. One of the protuberances which make up a compound berry, as in the Blackberry.

Acotyledonous. Having no cotyledons or seed lobes; as ferns.

Aculeate. Prickly.

Aculeus. A prickle; growing to the bark, not to the wood.

Acuminate. Ending in a long, produced, sharp point. More than acute; as in the leaves of the common Elm.

Acute. Ending in a sharp point.

Adnate. Growing to. Affixed laterally.

Agglomerated. Bunched. Crowded together.

Aggregate. Standing together, many on the same receptacle, but not compound.

Alated. See Winged.

Albumen. A tough, hard or fleshy substance which forms the bulk of certain monocotyledonous seeds.

Algæ. An order of the class Cryptogamia, containing the sea weeds, &c.

Alternate, Placed alternately on opposite sides of the stem.

Alveolate. With cells like those of a honey comb.

Ament, or Catkin. A collection of small scales, serving for calyces, on the side of a slender stalk; as in the Hazle, Willow, &c.

Amplexicaul. See Clasping.

Ancipital. Two edged.

Androgynous. Having barren and fertile flowers on the same spike, or the same plant, but no perfect ones.

Annual. Living but one year, during which it produces flowers and seed.
Anther. That part of a stamen or organ which contains the pollen.
Antheroid. Resembling anthers.
Apetalous. Without petals.
Apex. End, tip, or sharp extremity.
Aphyllous. Without leaves.
Appendiculate. Having some appendage.
Appressed. Pressed against or close to.
Apterous. Without wings. A term applied to some parts of flowers.
Arachnoid. Resembling a spider's web.
Arboreous. Like a tree.
Arborescent. Approaching to the size of a tree.
Aril. An outer covering of certain seeds, which is deciduous or separates; as in the Geraniums, Wood-sorrel, &c.
Aristate. Awned. Ending in a bristle.
Armed. Furnished with thorns or prickles.
Aroma. The aromatic quality of plants.
Articulated. Jointed.
Arundinaceous. Resembling reeds, or stiff large grass.
Ascending. Rising from the ground obliquely.
Attenuated. Gradually diminished or tapering.
Auriculate. Furnished with lateral projections, or leafets resembling ears, at base; as in the leaves of *Solanum dulcamara*, or Night-shade, &c.
Awn. A stiff bristle, frequently rough or bearded; as in the flowers of certain grasses, and in the anthers of most of the *Vacciniums*, or Whortleberries.
Awned. Having awns.
Awnless. Without awns.
Axil. The angle between a leaf and stem on the upper side.
Axillary. Growing in or from the axil.

B

Banner or *Vexillum.* The upper and commonly largest petal of a papilionaceous flower.
Barren. Producing no fruit. Containing stamens only.
Berry. A juicy fruit with the seeds imbedded in the pulp, without any intermediate covering.
Bicuspidate. With two points
Biennial. Living two years; in the second of which the flower and fruit are produced; as in the common Tree-primrose (*Œnothera biennis.*)
Bifid. Two cleft. Cut nearly into two parts
Biglandular. Having two glands.
Bilocular. Having two cells.

Bipinnate. Twice pinnate. When both the leaf and its subdivisions are pinnate.

Bipinnatifid. Twice pinnatifid. Both the leaf and its segments being pinnatifid.

Biternate. Twice ternate. The petiole supporting three ternate leaves.

Bivalve. Two valved.

Border. The brim, or spreading part of a corolla.

Brachiate. Branches opposite, and each pair at right angles with the preceding.

Bractè, or Floral leaf. A leaf near the flower which is different from the other leaves of the plant; as in *Euchroma coccinea*, and the singular support of the Linden flower.

Bulb. Generally a solid, coated or scaly succulent root; but sometimes found on the stem. The root of the Onion, Tulip, Lily, &c.

C

Caducous. Falling early; sooner than deciduous; as in the calyx of the Poppy.

Cæspitose or *Cespitose.* Forming turfs.

Calcarate. Resembling, or furnished with, a spur.

Calyciform. Shaped like a calyx.

Calyculated. Furnished with an additional outer calyx.

Calyx. The lowest portion of a flower, or that which forms its outer covering in the bud; usually of a green colour; as in the Rose, &c.

Campanulate. Bell-shaped.

Canescent. Whitish. Hoary.

Capillary. Hair like.

Capitate. Shaped like a head; or bearing a head.

Capsule. A hollow seed vessel which opens and becomes dry, when ripe.

Carina. The keel, or lower folded petal of a papilionaceous flower.

Carinated. Keeled. Furnished with a sharp or prominent back like the keel of a vessel.

Carnose. Fleshy in consistence.

Catkin. See *Ament.*

Caudate Having a tail; as in some seeds.

Caudex. The upper part of a root, which gives rise to the stem.

Caulescent. Having a true stem, or *caulis.*

Cauline. Growing on the stem.

Cell. A cavity or compartment of a seed vessel, or anther.

Cellular. Made up of little cells or cavities.

Chaffy. Made of short membranous portions like chaff.

Ciliate. Fringed with parallel hairs.

Cinereus. Ash coloured.

Cirrose, or *Cirrhose.* Bearing a tendril. From *Cirrus*, a tendril.

Clasping. Surrounding the stem partly or quite, with the base of the leaf.

Clavate. Club shaped. Larger at top than bottom.

Claw. The narrow part by which a petal is inserted or attached.

Cleft. Split or divided less than half way.

Club shaped. Larger at top than bottom.

Coadunate. United at base.

Coloured. Different from green which is the common colour of plants.

Column. The central pillar of a capsule. Also the style of gynandrous plants.

Compound. Made up of similar simple parts.

Compound flower. A flower of the class Syngynesia, consisting of florets with united anthers.

Compressed. Flattened.

Cone. A scaly fruit like that of the pine. See *Strobilus.*

Conglomerate. Crowded together

Connate. Opposite with the bases united or growing into one; as in the upper leaves of the Honeysuckle.

Connivent. Converging. The tips inclining towards each other.

Contorted. Twisted. Bent from a common position.

Corculum. The embryo or miniature of the future plant which is found in seeds, often between the cotyledons.

Cordate. Heart shaped, with the stalk inserted in the largest end.

Coriaceous. Resembling leather. Tough and thick.

Corneous. Horny. Having a consistence like horn.

Corniculate. Horn shaped.

Corolla. The secondary covering of a flower; being the part which is usually colored. When the calyx is wanting the corolla is then the primary covering; as in the Lily.

Cortical. Belonging to the bark.

Corymb. A mode of inflorescence in which the flowers form a flat top, while their stalks spring from different heights on the common stem; as in *Eupatorium perfoliatum.*

Costate. Ribbed.

Cotyledons. Seed lobes. The fleshy part of seeds which in most plants rises out of the ground and forms the first leaves.

Creeping. Running horizontally or close to the surface of the ground. Examples of a creeping root are found in *Coptis trifolia.* And of a creeping stem in *Gaultheria procumbens.*

Crenate. Scolloped. Having sharp notches on the edge separated by round or obtuse dentures; as in the leaves of *Coptis trifolia.*

Crenulate. Finely or minutely crenate.
Cribriform. Full of holes like a sieve. A term for certain tubes or vessels, in the vegetable structure.
Crowned. Having a circle of projections round the upper part of the tube of a flower, on its inside; as in the Catch-fly, and other *Silenes.*
Cruciform. Consisting of four petals placed like a cross.
Cryptogamous. Belonging to the class Cryptogamia; the last of the Linnæn arrangement, in which neither stamens nor pistils are visible.
Cucullate. Hooded or cowled. Rolled or folded in; as in the spathe of *Arum triphyllum* or Indian Turnip.
Cucurbitaceous. Like gourds or melons.
Culm, or straw. The stem of grasses, reeds, and similar plants.
Cuneiform. Shaped like a wedge; with the stalk attached to its point.
Cuspidate. Having a sharp, straight point.
Cuticle. The outside skin of a plant, commonly thin.
Cyathiform. Shaped like a common wine glass
Cylindrical. Round and not tapering. Cylinder shaped.
Cyme. A mode of inflorescence in which the flower stalks arise from a common centre, but are afterwards variously subdivided; as in *Elder, Viburnum,* and *Hydrangea.*
Cymose. Bearing or flowering in cymes.

D

Deciduous. Falling off. In opposition to persistent and ever-green. Later than *caducous.*
Declined, or declinate. Tending downwards; as the stamens and style of the Day-Lily, *Azalea,* &c.
Decompound. Twice compound. Composed of compound parts.
Decumbent. Leaning upon the ground, the base only erect.
Decurrent. When the edges of a leaf run down the stem or stalk, as in Comfrey.
Decursive. See *Decurrent.*
Decussated, or Decussating. In pairs crossing each other.
Deflected. Bent off.
Dehiscent. Gaping or cracking open.
Deltoid. Nearly triangular; as in the leaves of the Lombardy Poplar, &c.
Dentate. Toothed. Edged with sharp projections separated by notches. Larger than *serrate.*
Denticulate. Minutely toothed.
Dentures. Teeth. The sharp parts which separate notches.
Depauperated. Few flowered.
Depressed. Flattened or pressed in at top.
Diadelphous Having the stamens united in two parcels or sets. Flowers of this kind have commonly a papilionaceous corolla and a leguminous fruit.

Dichotomous. Forked. Dividing into two equal branches.
Dicoccous. Containing two grains or seeds.
Dicotyledonous. Having two cotyledons or seed lobes.
Didymous. Twin.
Didynamous. Belonging to the class Didynamia; with two short and two long stamens and a ringent corolla.
Digitate. When a petiole gives off five or more leafets from a single point at its extremity; as the Lupin and Horse-Chesnut.
Dimidiate. Halved.
Diœcious. Having the barren and fertile flowers on different plants.
Disk. The surface or top, in distinction from the edge.
Discoid. Having a disk covered with florets, but no ray.
Dissepiment. The partition or internal wall of a capsule.
Distichous. Growing in two opposite ranks or rows; as the leaves of the Hemlock-tree *(Abies).*
Divaricate. Diverging so far as to turn backward.
Divergent. Spreading. Separating widely.
Dorsal. Growing on, or belonging to, the back.
Drooping. Inclining downward. More than *nodding.*
Drupe. A fleshy fruit inclosing a stone or nut; like the cherry.
Drupaceous. Bearing, or resembling, drupes.

E

Echinate. Beset with prickles. Hedgehog like.
Elliptic. Oval; as the leaves of *Magnolia glauca.*
Elongated Exceeding a common or average length.
Emarginate. Having a notch in the end.
Ensiform. Sword shaped, two edged; as the leaves of the common *Iris.*
Entire. Even and whole at the edge.
Epidermis. See *Cuticle.*
Eroded. Appearing as if gnawed at the edge.
Esculent. Eatable.
Evergreen. Remaining fresh through the winter. Not deciduous.
Exserted. Projecting or extending out of the flower or sheath; as the stamens and style of the *Fuschia coccinea.*

F

Falcate. Sickle shaped. Linear and crooked.
Farina. The pollen. Also meal or flour.
Fascicle. A bundle.
Fascicled, or fasciculate. Collected in bundles.
Fastigiate. Flat topped.
Favose. Resembling a honey comb.
Ferns. An order of cryptogamous plants bearing the fructification commonly on the back of the leaf, or in spikes, made up of minute capsules opening transversely.

Fertile. Containing perfect pistils and yielding fruit.
Filiform. Thread like, or very slender.
Fimbriate. Finely divided at the edge like fringe.
Fistulous. Hollow or tubular. The leaf of the Onion.
Flabelliform. Spreading like a fan; as the leaves of some Palms.
Flagelliform. Like a whip lash.
Flexuous Serpentine or zigzag.
Floral leaf. See *Bracte.*
Floret. A little flower. One in an aggregate or compound flower.
Floscular. A floret in a compound flower which is tubular, not ligulate.
Follicle. A seed vessel which opens lengthwise or on one side only; as in *Asclepias*, or Milkweed.
Frond. The leaf of cryptogamous plants.
Fructification. The flower and fruit with their parts.
Frutescent. Becoming shrubby.
Fruticose. Shrubby.
Fungi. The order of Cryptogamous plants to which the Mushrooms belong.
Fungous. Growing rapidly and preternaturally; with a soft texture like the *fungi.*
Funnel shaped. Tubular at bottom and gradually expanding at top; as the flowers of *Datura Stramonium.*
Furfuraceous. Resembling bran.
Fusiform. Spindle shaped. When a root is large at top and tapers downward, as in the carrot and radish.

G

Gemmaceous. Belonging to a bud. Made of the scales of a bud.
Generic. Belonging to a genus.
Geniculate. Bent like a knee.
Genus. A family of plants agreeing in their flower and fruit.
Germ The lower part of the pistil, which afterwards becomes the fruit.
Germination. The sprouting of a seed.
Gibbous. Swelled out, commonly on one side.
Glabrous. Smooth, as it regards hairiness or pubescence.
Gland. A small roundish appendage, apparently performing some function of secretion or excretion; as on the petiole of the blue Passion-flower.
Glandular pubescence. Hairs tipped with little heads or glands.
Glaucous. Sea green. Pale blueish green.
Glume. The scales, valves, or chaff, which make the calyx and corolla of grasses.
Glutinous. Adhesive, viscid, covered with an adhesive fluid.
Gramina. Grasses and grass like plants.

Gramineous. Resembling grasses.
Granular. Formed of grains, or covered with grains.
Gymnospermous. Having naked seeds.
Gynandrous. Having the stamens growing on the pistils.

H

Habit. The general external appearance of a plant, by which it is known at sight.
Halberd shaped. See *Hastate.*
Hastate. Shaped like a halberd. It differs from *arrow shaped* in having the barbs or lateral portions more distinct and divergent.
Head. A dense, round collection of flowers, which are nearly sessile; as in common Clover.
Helmet. The concave upper lip of a labiate flower.
Herb. All that portion of a plant which is not included in the root or fructification; as the stem, leaves, &c.
Herbaceous. Not woody.
Hermaphrodite. See *Perfect.*
Hilum. The scar or mark on a seed, where it was attached to the plant or seed vessel; as in Beans, Peas, &c.
Hirsute. Rough with hairs.
Hispid. Bristly. More than hirsute.
Hooded. See *Cucullate.*
Horn. See *Spur.*
Hybrid. A mongrel or intermediate species between two others, from which it is descended.
Hypocrateriform. Salver shaped. With a tube abruptly expanded into a flat border.

I

Icosandrous. Having about twenty stamens growing on the calyx and not on the receptacle. Belonging to the class Icosandria.
Imbricate. Lying over each other like scales, or the shingles of a roof.
Included. Wholly received or contained in a cavity. The opposite of *exserted.*
Incrassated. Thickened upward. Larger toward the end.
Incumbent. Lying against or across.
Indigenous. Native. Growing originally in a country.
Indusium. Plural Indusia. The involucre or veil which covers the fruit of ferns.
Inferior. Lowermost. Used to express the relative situation of the calyx and germ. An inferior flower is one in which the calyx and corolla are below the germ.
Inflated. Tumid and hollow. Blown up like a bladder.
Inflorescence. The manner in which the flowers are situated or connected with the plant, and with each other.
Infundibuliform. Funnel shaped, which see.

Inserted into. Growing out of.

Internode. The space between joints; as in Grasses.

Interruptedly pinnate. When smaller leafets are interposed among the principal ones.

Involucre, or *Involucrum.* A sort of general calyx serving for many flowers; generally situated at the base of an umbel, or head; as in *Conium maculatum* (Hemlock) and *Cornus florida.* Also the Indusium.

Involucel. A partial involucre.

Irregular corolla. Having its upper and lower sides unlike.

K

Keel. The under petal of a papilionaceous flower. Also the lower side of the midrib of a leaf.

Keeled. Shaped like a keel.

Kidney-shaped. Heart-shaped without the point, and broader than long.

L

Labiate. Having an upper and lower lip, as in flowers of the class Didynamia.

Laciniate. Cut, torn, and jagged.

Lactescent. Yielding a white, or milky juice, when wounded; as in the Poppy.

Lamellated. In thin plates.

Lamina. The border or flat end of a petal, in distinction from its claw. Also a thin layer, plate, or membrane of any kind.

Lanceolate. Spear shaped. Narrow, with both ends acute, as in the leaves of Privet, and Persian Lilac.

Lanuginous. Woolly.

Lateral. At the side.

Leafet. A partial leaf A constituent of a compound leaf.

Legume. A pod or seed vessel having its seeds attached to one side or suture; commonly of a long form and not jointed. In the Pea, Bean, &c

Leguminous. Bearing legumes.

Lepanthium. A petaloid nectary, as in Larkspur and Monkshood.

Liber. The inner bark.

Ligneous. Woody.

Ligulate. Ribbon shaped. A kind of corolla found in compound flowers, consisting of a tube at bottom, continued into a long flat portion at top; as in the florets of the Dandelion, Succory, &c.

Liliaceous. Resembling the Lily.

Limb. The border or spreadng part of a monopetalous corolla.

Linear. Long and very narrow with parallel sides; as the leaves of grasses.

Lip. The upper or under side of the mouth of a labiate corolla; as in Sage, Hyssop, &c.

Lobe. A large division or distinct portion of a leaf or petal. See the leaves of Sassafras, &c.
Loment. A pod resembling a legume, but divided by transverse partitions.
Lyrate. Pinnatifid, with a large roundish leafet at the end.

M

Marcescent. Withering.
Maritime. Growing near the salt water.
Medulla. The pith.
Membranous. Very thin and delicate.
Midrib. The large central vein of a leaf which is a continuation of the petiole.
Monadelphous. Having the stamens united into a tube at base.
Moniliform. Arranged like the beads of a necklace.
Monœcious. Having barren and fertile flowers on the same plant.
Monopetalous. Having but one petal, *i. e.* the corolla of one piece.
Monophyllous. Consisting of one leaf, or piece. Applied to the calyx.
Mosses, Musci. The second order of the class Cryptogamia.
Mucronate. Having a small point projecting from an obtuse end.
Multipartite. Many parted.
Muricate. Covered with sharp spines or prickles.

N

Nectariferous. Bearing honey.
Nectary. The part of the flower which produces honey. The term is also applied in certain instances to any internal, superaumerary part of the calyx or corolla.
Nerves. Parallel veins.
Nerved. Marked with nerves, so called, though not organs of sensibility.
Nodding. Inclining to one side. Partly drooping.

O

Ob. A particle, which when prefixed to any other term, denotes the inversion of the usual position; as obovate, obcordate, &c , *i. e.*, inversely ovate, inversely cordate, &c.
Obconic. Conic with the apex downward.
Obcordate. Heart shaped with the point inward, or downward; as in Wood-Sorrel.
Oblong. Longer than oval with the sides parallel.
Obovate. Ovate, but inverted.
Obsolete. Indistinct. Appearing as if worn out.
Obtuse. Blunt, rounded, not acute.
Ochroleucous. Whitish yellow, cream-color.
Officinal. Kept for sale as medicinal.
Opaque. Not transparent.

Operculum. The lid which covers the capsules of mosses.
Opposite. Standing directly against each other on opposite sides of the stem; as the leaves of the Lilac.
Orbicular. Circular.
Oval. Elliptical; as the leaves of *Magnolia glauca.*
Ovate. Egg shaped. Oval with the lower end largest; as the leaves of the Pear-tree.

P

Palate. A large obtuse projection which closes the throat of a personate flower; as in Toadflax.
Paleaceous. Chaffy.
Palmate Hand shaped. Deeply divided into spreading and somewhat equal segments; as the leaves of the Castor-oil plant *(Ricinus communis.)*
Panduriform. Contracted in the middle like a violin.
Panicle. A loose, irregular bunch of flowers, with subdivided branches; as in Meadow-grass *(Poa pratensis.)*
Papilionaceous. Having an irregular corolla like the pea blossom; consisting of four petals, of which the uppermost is called the *vexillum* or *banner;* the two lateral ones, *alæ* or *wings:* and the lower one, commonly boat-shaped, the *carina* or *keel.* Mostly belonging to the class Diadelphia.
Pappus. The down of seeds; as that of the Dandelion. A feathery appendage.
Parasitic. Growing on another plant and drawing nourishment from it; as the Misseltoe.
Parenchyma. The cellular substance of vegetables.
Partial. This term is applied to small or constituent parts in distinction from general.
Partition. The dividing wall or dissepiment in seed vessels.
Parted. Deeply divided; more than cleft.
Pectinate. Like the teeth of a comb. Intermediate between fimbriate and pinnatifid.
Pedate. Having a central segment or leaf which is simple, and two lateral ones which are compound. *Viola pedata.*
Pedicel. The ultimate branch of a peduncle A little stalk.
Peduncle. A stem bearing flowers or fruit exclusively; as the Cherry stalk.
Pellicle. A very thin stratum or coat.
Peltate. Having the stalk attached to some part of the surface or disk, and not to the margin, as in Nasturtium, May-apple *(Podophyllum)*, &c.
Pendulous. Hanging down.
Pencilled. Ending like a painter's pencil or brush.
Perennial. Lasting more than two years.
Perfect flower. One which possesses stamens and pistils, and produces fruit.

Perfoliate. Surrounding the stem on all sides and perforated by it. It differs from connate, in not consisting of two leaves. *Eupatorium perfoliatum,* or American Thoroughwort.

Perianth. A sort of calyx which is immediately contiguous to the other parts of fructification. The calyx properly so called.

Pericarp. A seed vessel, or whatever contains the seed.

Permanent. See *Persistent.*

Persistent. Not falling off. Those parts of a flower are persistent which remain till the fruit is ripe.

Personate. Masked. Having the mouth of the corolla closed by a prominent palate ; as in the Toadflax *(Antirrhinum.)*

Petal. The leaf of a corolla, usually coloured.

Petaloid. Resembling petals.

Petiole. The stalk which supports a leaf

Phænogamous. Not Cryptogamous. Applied to all plants which have visible flowers containing stamens and pistils.

Pilose. Hairy. With a stiff pubescence.

Pinnæ. The leafets or divisions of a pinnate leaf.

Pinnate. A leaf is pinnate when the leafets are arranged in two rows on the side of a common petiole ; as in the Ash, Elder, and Rose.

Pinnatifid. Cut in a pinnate manner. It differs from pinnate in consisting of a simple or continuous leaf, not compound.

Pistil. A constituent part of a flower including the germ, style, and stigma. In a regular flower it forms the central part.

Pistillate. Having pistils, but no stamens.

Plaited. Folded like a ruffle or fan ; as the leaves of *Veratrum viride.*

Plumose. Feathery. Feather like.

Plumula. Part of the corculum of a seed, which afterwards forms a new plant with the exception of the root.

Pod. A dry seed vessel, not pulpy; most commonly applied to legumes and siliques.

Pointal. See *Pistil.*

Polyandrous. Having many disconnected stamens inserted into the receptacle.

Polycotyledonous. Having seeds with more than two cotyledons ; as in the Pines.

Polygamous. Having some flowers which are perfect, and others which have stamens only, or pistils only.

Polygynous. Having many styles.

Polymorphous. Changeable. Assuming a variety of forms.

Polypetalous. Having many petals.

Polyphyllous. Having many leaves. Applied to the calyx.

Pome. A pulpy fruit having a capsule within it ; as the apple and pear.

Præmorse. Bitten off The same as *abrupt.*
Prickle. The prickle differs from the thorn in being fixed to the bark only and not to the wood.
Prismatic. Having several parallel, flat sides.
Procumbent. Lying on the ground.
Proliferous. An umbel or flower is said to be proliferous when it has smaller ones growing out of it.
Pseudopinnate. Falsely or imperfectly pinnate, not resolving at any time into separate leafets; as the Pea, Vetch, &c.
Pubescent. Hairy or downy.
Pulp. The soft, juicy, cellular substance found in berries and similar fruits.
Pulverulent. Dusty. Composed of powder, or appearing as if covered with it.
Punctate. Appearing as if pricked full of small holes, or dots.
Punctiform. Resembling dots.
Pungent. Sharp, acrid, pricking.
Putamen. A hard shell.

Q

Quaternate. Four together.
Quinate. Five together.

R

Raceme. A cluster; a kind of inflorescence in which the flowers are arranged by simple pedicels on the sides of a common peduncle; as the Currant *(Ribes.)*
Rachis. The common stalk to which the florets and spikelets of grasses are attached. Also the midrib of some leaves and fronds.
Radiate. Having ligulate florets placed like rays at the circumference, in certain compound flowers; as in White-weed or Ox-eye Daisy; or having the outer petals or flowers largest, as in certain cymes and umbels.
Radical. Growing immediately from the root.
Radicle. The part of the corculum which afterwards forms the root. Also the minute fibre of a root.
Ray. The diverging florets or petals which form the outside of radiate flowers, cymes, and umbels.
Receptacle. The end of a flower stalk; being the base to which most or all the parts of fructification are attached.
Reclined, or *Reclining.* Bending over, with the end inclining toward the ground; as in the Bramble.
Recurred. Curved backwards.
Reflexed. Bent backward, more than recurved.
Reniform. Kidney shaped. Heart shaped without the point.
Repand. Slightly wavy or serpentine at the edge.
Resupinate. Turned upside down; as the corolla of *Trichostema.*
Reticulate. Net like. Having veins distributed like net work.

Retuse. Having a slight sinus, or superficial notch in the end Less than emarginate.
Revolute. Rolled backward or outward.
Rhomboidal. Having four sides with unequal angles.
Ribbed. Marked with parallel ridges or veins.
Ringent. Irregular, with an upper and under lip. See *Labiate*
Rooting. Sending out lateral roots.
Rostellum. See *Radical.*
Rostrate. Furnished with a beak.
Rotate. Wheel shaped. Flat without a tube; as in the flowers of *Anagallis, Lysimachia,* and *Veronica.*
Rugose. Wrinkled. Leaves of Sage.
Runcinate. Having large teeth pointing backward; as the leaves of the *Dandelion.*

S

Sagittate. Arrow shaped. Like the head of an arrow. See *Sagittaria.*
Salvar shaped. See *Hypocrateriform.*
Samara. A seed vessel not opening by valves, having a winged or membranous appendage; as in the seed vessel of the Elm.
Sarmentose. Running on the ground and striking roots from the joints, as the *strawberry.*
Scape. A stalk which springs from the root, and supports flowers and fruit, but no leaves. See the Plaintain and Dandelion.
Scabrous. Rough.
Scarious. Having a thin membranous margin. The calyx scales of *Liatris scariosa.*
Scions. Lateral shoots or offsets from the root.
Scrobiculate. Covered with deep, round pits.
Segment. A part or principal division of a leaf, calyx, or corolla.
Semibivalvular. Half divided into two valves.
Sericeous. Silky.
Serrate. Notched like the teeth of a saw, the points tending upward; as in strawberry and rose leaves.
Serrulate. Minutely serrate.
Sessile. Placed immediately on the stem, without the intervention of a stalk.
Setaceous. Bristle like.
Sheath. A tubular or folded leafy portion inclosing the stem. See the leaves of Grasses.
Silicle. A seed vessel constructed like a silique, but not longer than it is broad. See Shepherd's-purse.
Silique. A long pod or seed vessel of two valves, having its seeds attached to the two edges alternately.
Siliquose. Having siliques.
Simple. Not divided, branched, or compounded.

Sinuate. Having sinuses at the edge.
Sinus. A large, rounded indentation or cavity.
Sori. Plural of *Sorus.* The most common fruit of ferns, consisting of small clusters of minute capsules on the back of the leaf.
Spadix. An elongated receptacle of flowers, commonly proceeding from a spathe ; as in *Arum triphyllum.*
Spathe. A sheathing calyx opening lengthwise on one side, and consisting of one or more valves ; as in the Onion. See *Spadix*
Spatulate or *spathulate.* Obtuse or large at the end, and gradually tapering into a stalk at base.
Species. A group or subdivision of plants agreeing with each other not only in their fructification, but in all other essential and permanent parts ; and always reproducing the same kind.
Specific. Belonging to a species only.
Spike. A kind of inflorescence in which the flowers are sessile, or nearly so, on the sides of a long peduncle.
Spikelet. A small spike ; as in Meadow-grass, Darnel, Cheat, &c.
Spindle shaped. See *Fusiform.*
Spine. A thorn, or sharp process growing from the wood.
Spur. A sharp hollow projection from a flower, commonly the nectary.
Squamiform Scale shaped.
Squarrose or *Squarrous.* Ragged. Having reflected or divergent scales.
Stamen. The part of the flower on which the Linnæan classes are founded. It commonly consists of the *filament* or stalk, and the *anther* which contains the pollen.
Staminate. Having stamens, but no pistils.
Standard. See *Banner.*
Stellate. Like a star.
Stem. A general supporter of leaves, flowers, and fruit.
Stemless. Having no stem properly so called, but only a scape.
Sterile. Barren.
Stigma. The summit or extremity of the pistil.
Stipe. The stem of a fern or fungus ; also the stem of the down of seeds, as in Dandelion ; also a particular stalk of germs, seeds, &c., which is superadded to the pedicel.
Stipitate. Supported by a stipe.
Stipule. A leafy appendage situated at the base of petioles or leaves.
Stipular. Belonging to stipules.
Stoloniferous. Having scions or running shoots.
Striate. Marked with fine parallel lines.
Strigose. Bristly.
Strobile. A cone ; an ament with woody or rigid scales, as in the fruit of pines, firs, &c.

Style. The part of the pistil which is between the germ and stigma.
Sub. A particle prefixed to various terms, to imply the existence of a quality in a diminutive or inferior degree, as
Subacute. Somewhat acute. Less than acute, &c.
Subsessile. Nearly sessile.
Subserrate. Slightly serrate, &c.
Subulate. Awl shaped. Narrow, stiff and sharp pointed.
Succulent. Juicy.
Sucker. A shoot from the root, or lower part of the stem.
Suffruticose. Somewhat shrubby. Shrubby at base.
Sulcate. Furrowed.
Supradecompound. More than decompound. Many times subdivided.
Suture. The line or seam formed by the junction of two valves of a seed vessel.

T

Tendril. A filiform appendage of certain vines, which supports them by twining round other objects.
Terete. Round, cylindrical.
Terminal. Extreme, situated at the end.
Ternate. Three together; as the leaves of common Clover, Kidney-beans, &c.
Tetradynamous. Having four long and two short stamens.
Tetrandrous. Having four stamens.
Thorn. See *Spine.*
Throat. The passage into the tube of a corolla.
Thyrse. A close, compact panicle.
Tomentose. Downy. Covered with fine matted pubescence.
Trifid Three cleft.
Trifoliate. Three leaved. See *Ternate.*
Trilobate. Three lobed.
Trilocular. Three celled.
Tripartite. Three parted.
Trivial name. The specific name.
Truncate. Having a square termination as if cut off; as the leaves of *Liriodendron tulipifera,* or Tulip tree.
Tuber. A solid, fleshy knob.
Tuberous. Thick and fleshy, containing tubers; as the roots of the Potatoe, Pæony, &c.
Tubular. Shaped like a tube. In a compound flower, the florets which are not ligulate, are called tubular.
Tunicated. Coated with concentric layers; as the Onion.
Turbinate. Shaped like a top or pear.

V

Valves. The segments or parts of a seed vessel, into which it finally separates. Also the leaves which make up a glume or spathe.

Variety. A subdivision of a species, distinguished only by characters which are not permanent; and which does not with certainty reproduce its kind; as the varieties of Tulips, Peaches, &c.

Vaulted. Arched over; with a concave covering.

Veined. Having the divisions of the petiole irregularly branched on the under side of the leaf.

Ventricose. Swelling. Inflated.

Verrucose. Warty. Covered with little protuberances.

Vertical. Perpendicular.

Verticillate. Whorled. Having leaves given off in a circle round the stem.

Vesicular. Made of vesicles or little bladders.

Vespertine. Opening in the evening; as the flowers of the *Stramonium*, and Tree-Primrose.

Villous. Hairy, the hairs long and soft.

Virgate. Long and slender. Wand like.

Virose Poisonous, nauseous, and strong to the smell.

Viscid. Thick, glutinous, covered with adhesive juice.

Vitellus. A part of certain seeds distinct from the albumen, but not rising out of the ground at germination.

Viviparous. Producing a collateral offspring by means of bulbs.

U

Umbel. A kind of inflorescence in which the flower stalks diverge from one centre like rays; as in the Parsnip, Parsley, &c.

Umbelliferous. Bearing umbels.

Umbilicate. Marked with a central depression.

Unarmed. Without prickles or thorns.

Uncinate. Hooked, hook shaped.

Undulated. Wavy, serpentine, gently rising and falling.

Unguiculate. Inserted by a claw.

Unilateral. Growing all on one side, or with the flowers leaning to one side.

Urceolate. Pitcher shaped. Swelling in the middle and slightly contracted at top.

W

Wedge shaped. Formed like a wedge, and commonly rounded at the largest end.

Wheel shaped. See *Rotate.*

Wings. The two lateral petals of a papilionaceous flower.

Winged. Having the sides extended into a leafy expansion.

END.

EXPLANATION OF THE PLATES.

PLATE I.

A LILIACEOUS FLOWER.

FIG. 1.—A flower of the common White Lily (*Lilium candidum*). The 3 inner petals present a longitudinal nectariferous groove.

FIG. 2.—*a.* The 6 stamens and pistillum. *b.* The receptacle or common base of insertion.

FIG. 3.—The pistillum. *a.* The germ. *b.* The style. *c.* The stigma, which is 3-lobed.

FIG. 4.—The stamen. *a.* The subulate or awl-shaped filament. *b.* The oblong anther.

FIG. 5.—The mature capsule. *a.* The cancellate threads, which guard the opening of the valves.

FIG. 6.—A transverse section of the capsule, exhibiting its internal division into 3 cells, with 3 valves. *a.* The cells or chambers. *b. b.* The triangular flat seeds, disposed in a double row in each cell.

PLATE II.

THE ORDER OF CRUCIFEROUS FLOWERS.

FIG. 1.—A branch of the Sea-side Stock (*Cheiranthus maritimus*). The leaves oblong and sessile.

FIG. 2 —The disposition of the stamens in 2 sets. *a.* The 4 longer, and *b.* the 2 shorter, rendered so by the interposition of the 2 glands *c.* betwixt their base and that of the germ.

FIG. 3.—A petal consisting of *a.* The border, and *b.* The stalk, narrowed part, or claw (*unguis*).

FIG. 4.—The pod or silicle ; the kind of fruit common to the first order of Cruciferous flowers. *a.* The valves. *b.* The partition or dissepiment dividing this kind of fruit into 2 cells, with the seeds attached alternately to its filiform margins.

FIG. 5.—A small aquatic plant called *Awlwort (Subularia aquatica)*, indigenous to the alpine lakes of Europe, and also to the ponds of Maine. The leaves linear, subulate, and verticillated. *a*. The SILICLE, or short pod, of an oval figure. *b*. The dissepiment and concave valves.

FIG. 6.—The irregular cross-shaped flower of the Candytuft (*Iberis umbellata*), in which 2 of the external petals are enlarged.

FIG. 7.—The open silicle of the Shepherd's-purse (*Thlaspi Bursa-pastoris*).

FIG. 8.—The unopen, triangularly obcordate silicle.

PLATE III.

PAPILIONACEOUS OR LEGUMINOUS PLANTS.

A small branch of the Sweet Pea (*Lathyrus odoratus*). The stem angular and scandent or supporting itself by the tendrils or claspers of the leaves. The pinnate leaf furnished with *stipules* or small leafy processes at its base. The place of 5 upper leaflets represented by so many undivided tendrils. The *peduncle* or flower-stalk, supporting 2 flowers.

FIG. 1.—The Legume or pod, the general fruit or pericarp of this tribe of plants, dividing into 2 valves or portions, with but one cavity or cell, and the seeds attached to the upper margin or suture.

FIG. 2.—The papilionaceous flower of *Lathyrus sylvestris* dissected. *a*. The 5-toothed calyx. *b*. The *vexillum*, or banner, the larger upper petal. *c*. The *alæ*, or wings, the 2 lateral petals. *d*. The *carina* or keel, formed of 2 petals cohering by their 2 edges, but with 2 distinct claws, or narrow bases. *e*. The 10 stamina, 9 united and 1 separate. *f*. The pistillum.

FIG. 3.—A raceme of the flowers of the Honey-locust (*Gleditschia triacanthos*), given as an example of a leguminous plant, with a regular flower, consisting of a calyx and equal bordered calycine corolla. *a*. The fertile flower. *b*. The staminiferous flower. *c*. The 1-seeded legume or loment of the *G. monosperma*.

FIG. 4.—The flower of a species of *Petalostemon,* in which 5 of the filaments produce petals instead of anthers, as at *a*. *b*. The stamens.

PLATE IV.

LABIATE FLOWERS.

FIG. 1.—A branch of Ground-Ivy (*Glechoma hederacea*), with opposite, petiolated, reniform leaves, crenated on the margin,

with the flowers in axillary clusters, having the appearance of being verticillated. *a*. The upper lip of the monopetalous corolla, which is 2-lobed. *b*. The lower lip, with 3 lobes. *c*. The anthers converging in opposite pairs, so as to put on the appearance of a cross, a character given as the peculiar mark of the genus. *d*. The calyx, in the bottom of which is seated the 4 naked seeds.

FIG. 2.—A flower of the *Teucrium fruticans*. *a*. The lower lip in 3 lobes, the central lobe much larger. The upper lip of 2 lobes, cleft, and *b*. The stamens coming out of the fissure.

FIG. 3.—*a*. The personate or masked flower of the Toad-flax (*Antirrhinum Linaria*), the palate being closed by the convex projection of the lower lip, which below terminates in a spur. *b*. The disposition of the stamens converging by pairs of unequal length; near the base of the shorter pair there is the rudiment of a 5th stamen. *c*. The capsule of 2 cells opening on either side by a number of reflected teeth, the dissepiment and adhering style presenting the appearance of a spur.

FIG. 4.—*a*. The *Peloria* or regularized and perfected flower of the Toad-flax, having a regular 5-lobed reflected border, 5 equal stamens, and 5 equidistant spurs below. *b*. The same laid open to show the stamens.

FIG. 5.—*a*. The flower of *Prunella vulgaris*, or Self-heal. *b*. The stamens characterized by their forked filaments, one of the extremities only producing an anther.

FIG. 6.—A small branch of *Erinus alpinus*, in which the didynamous flower has a nearly equal and regular border.

PLATE V.

UMBELLIFEROUS PLANTS.

FIG. 1.—A branch of the American Coriander with triternately dissected, narrow cleft leaves, (*Coriandrum* * *americanum*).† *a*. The didymous fruit. *b*. The involucrum beneath the umbel. *c*. The involucellum, beneath the umbellet or partial umbel.

FIG. 2.—A separate flower with its 5 obcordate inflected petals. *a*. A petal. *b*. A stamen.

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† The following is the specific character of this undescribed species. *American Coriander*, with didymous fruit; umbel perfect, involucrum general and partial many-leaved. ⊙ HAB. (or locality). Found in the prairies of Red River territory; common.

Fig. 3.—*b.* The unripe spherical fruit of the common Coriander. *a.* The styles.

Fig. 4.—The linear or narrow oblong fruit of the genus *Chærophyllum.*

Fig. 5.—The fruit of *Angelica atropurpurea.* Roundish elliptic, and solid, with 3 elevated ribs in the centre of each seed.

Fig. 6.—The fruit of a species of *Laserpitium.* The form oblong-elliptic, with all the ribs of the seed conspicuously winged.

Fig. 7.—The oblong fruit of *Thapsia latifolia,* having winged margins.

Fig. 8.—The fruit of the Carrot (*Daucus*), clothed with barbed or hispid hairs.

Fig. 9.—That of the Parsnip (*Pastinaca sativa*), elliptic, flatly compressed, and with the ribs very indistinct or obsolete.

Fig. 10.—The large, subovate, corky barked, angular fruit of a species of *Cachrys.*

Fig. 11.—The fruit of *Astrantia major,* with thin membranaceous margins, and terminated by a conspicuous 5-parted calyx.

Fig. 12.—*Hydrocotyle vulgaris,* or Marsh Pennywort. *a.* The umbel, which is simple. *b.* A flower with the petals flat and ovate. *c.* The fruit with its styles, which is laterally compressed, or flattened in an opposite direction to that of the Parsnip. *d.* The peltate leaf, or one with the petiole inserted into the disk.

Fig. 13.—An umbellet of *Tordylium syriacum,* with its involucellum. The fruit (after the manner of the genus) flat and suborbicular, with a callous crenate margin.

Fig. 14.—The fruit of the *Æthusa,* or Fool's Parsley, which is nearly ovate, with 5 acute and turgid ridges on each seed, having their channelled intervals acute-angular. The involucrum, if present, is inclined to one side and pendent.

Fig. 15.—The fruit of the Hemlock (*Conium maculatum*) magnified, of an ovate and gibbous form, the seeds 5-ribbed, the ribs at first crenated.

PLATE VI.

COMPOUND FLOWERS.

Fig. 1.—The wild Daisy of Europe (*Bellis perennis*). The leaves radical, obovate, and crenate. The flowers produced on *scapes* (or radical peduncles). The general calyx hemispherical, or cup-shaped, with the scales all of equal length. The flower composed of 2 kinds of florets. *a.* The flat or radial florets. *b.* The discal florets.

FIG. 2.—An enlarged radial floret. *a.* The flat or strap-shaped border. *b.* The tube with the bifid stigma and style, but without stamens, and therefore imperfect. *c.* The germ, destitute of down or pappus.

FIG. 3.—One of the tubular perfect florets, possessed of the tube of stamens and the style.

FIG. 4.—Exhibiting a section of the naked conic receptacle and persisting calyx.

FIG. 5.—A small branch of *Arctotis anthemoides*, with bipinnatifid leaves, and exhibiting its appearance in seed. *a.* One of the seeds crowned with a 5-leaved chaffy pappus, analogous to the character of a true calyx.

FIG. 6.—The floret of a Thistle. *a.* The tubular 5-cleft floret. *b.* The undivided cylindric stigma. *c.* The germ. *d.* The downy pappus.

FIG. 7.—The flower of the Dandelion (*Leontodon Taraxacum*), made up of strap-shaped perfect florets. *b.* The lower part of the calyx, which is reflected. *a.* The runcinate leaf, or with the sharp segments reflected downwards.

FIG. 8.—An enlarged floret of the above. *a.* The notched floret. *b.* The tube of anthers.

FIG. 9.—*a.* The cylinder of 5 united anthers. *b.* The 5 filaments. *c.* The style, with its bifid stigma.

FIG. 10.—The ripe seed, with a stipitate or stalked pappus. *a.* The pappus. *b.* The stipe. *c.* The seed.

PLATE VII.

THE PRINCIPAL FORMS OF SIMPLE LEAVES.

FIG. 1.—A peltate orbicular leaf, or one with the petiole inserted into the disk so as to represent a shield or target. (*Tropæolum*, or *Indian Cress*).

FIG. 2.—A reniform leaf, with a crenate or roundly toothed margin. (*Ground-Ivy*).

FIG. 3.—A cordate or heart-shaped leaf, with an acuminated point and a serrated margin. (*Aster cordifolium*).

FIG. 4.—An ovate entire leaf. (*Vinca minor*).

FIG. 5.—A lanceolate acuminated leaf, with a serrulated margin. *a.* The cleft *stipules* or foliar appendages. (The Peach tree).

FIG. 6.—A linear, acuminated, and sheathing leaf;—that of the Grasses.

FIG. 7.—A deltoid or triangular, serrated leaf. (Lombardy Poplar).

Fig. 8.—A cuneiform or wedge-shaped leaf. *(Myrica Gale).*

Fig. 9.—A sagittate or arrow-shaped leaf, with acuminated auricles and point. *(Sagittaria sagittifolia).*

Fig. 10.—A palmated or hand-shaped leaf, with serrated margins. *(Rubus odoratus).*

Fig. 11.—A pedate cleft leaf, or one with deflected or descending segments. *(Viola pedata).*

Fig. 12.—Connate leaves, or ingrafted together at the base. *(Caprifolium).*

Fig. 13.—Imbricated leaves, or mutually incumbent, like tiles on the roof a house. *(Erica vulgaris).*

Fig. 14.—Verticillated, linear, or stellated leaves; more than 2 from the same point of the stem. *(Galium).*

Fig. 15.—Amplexicaule or clasping leaf, being also entire, lanceolate-arrow-shaped. *(Woad).*

Fig. 16.—A decurrent lanceolate leaf, or with the edges running down upon the stem. *(Comfrey).*

Fig. 17.—Acerose leaves, needle-formed, clustered and sempervirent. (*Pinus Strobus.*)

Fig. 18.—A 4-winged leaf, or 2 leaves ingrafted together by their surfaces. *a.* A section of the same with its laminated margins. *(Gladiolus pterophyllus).*

Fig. 19.—The quadrangular acerose leaf of the Fir. *(Abies).*

Fig. 20.—The clustered filiform linear leaves of the Larch, forming, in fact, an abortive branch, the terminal one only, in common, perfected. No. 17, and all the clustered leaves of the Pines, may be also considered similar.

PLATE VIII.

LEAVES, AND THEIR APPENDAGES.

Fig. 1.—A 3-lobed entire leaf. *(Hepatica).*

Fig. 2.—A ternate leaf, maculated or blotched. *a.* The membranous ingrafted stipules. *(Trifolium pratense).*

Fig. 3.—A binate or 2-parted leaf, with a deeply indented border. *(Jeffersonia diphylla).*

Fig. 4.—A digitate leaf, or with 5 or more divisions or leaflets, like the fingers of the hand. The form of the leaflets obovate or inversely egg-shaped, acuminated and serrated. *(Æsculus glabra).*

Fig. 5.—Pinnatifid, or cleft in opposite parallel segments, like the web of a feather. In this example the divisions are so closely

parallel that it is said to be pectinately-pinnatifid, or cleft like the teeth of a comb *(pecten).* [*Othonna pectinata.*]

FIG. 6.—A pinnate or feathered leaf, not merely cleft, but presenting parallel rows of leaflets. *a.* The adnate petiolar cleft stipule. (A Rose leaf).

FIG. 7.—A bipinnate or twice pinnated leaf, said to be equally pinnate, as the pinnæ end in even pairs. The base subtended by thorny stipules. (*Mimosa,* species.)

FIG. 8, 9, 10.—A series of leaves having their edges variously ingrafted. 8. The sheathing linear channelled leaf of the Spiderwort *(Tradescantia virginica).* *a.* The embracing margins ingrafted together so as to produce a short, cylindric, uncleft sheath; in Grasses these sheaths are open to the base.

FIG. 9.—Leaves of the *Phormium tenax,* or New Zealand Flax. At *b.* they mutually sheath and are compressed. At *a. a.* the sheathing margins unite or become ingrafted and are no longer sheathing, but above, the keeled leaf again expands, and presents the usual natural appearance of grass leaves.

FIG. 10.—Is the leaf of a species of Iris; at *a.* it is open and sheathing, but at *b.* the two edges become ingrafted together, so as to produce a very unusual leaf of a sword-shaped oblique form, thick and rigid, and of the same appearance on both surfaces. From this form to that of the tubular leaves, or *ascidia* of *Sarracenia,* the transition appears sufficiently natural, as in

FIG. 11, at *a.* The ingrafted edges of the leaf, like those of *Iris,* are visible in the form of a dorsal leafy ridge, the base of the petiole or foot-stalk is also open and sheathing. *b.* Represents the midrib transformed into a ventricose open tube, surmounted by an inclined auricular lid. The leaf of the Onion is altogether tubular, yet other species of *Allium* present solid, flat, or semicylindric foliage, not very dissimilar to the leâves of Grasses; such hollow leaves then, as those in question, have the midrib hollow or inflated. In *Lobelia Dortmanna* the leaves have *two* longitudinal cavities, the *unaltered* midrib forming a partition between the tubular cavities, which take place in the laminæ of the leaves.

FIG. 12.—The curious *ascidia* of *Nepenthes distillatoria* attached towards the extremity of the leaf. *a.* The double dorsal or foliar laminæ. *b.* The tubular midrib.

FIG. 13.—The curious *ascidium* of the *Cephalotus follicularis* of New Holland, a circle of which around the scape or flower-stalk are blended with *a.* the true leaves. *b.* The ventricose pitcher with grooves and saliant ridges edged with bristly hairs. *c.* The concave lid. *d.* The annulated margin, within presenting a row of circular inflected hooks.

FIG. 14.—*a.* The leaf, and *b.* the ciliated irritable trap-like appendage of the *Dionæa muscipula*, or Fly-trap. *c.* One of the few glandular hairs or bristly processes (enlarged), situated on either side the centre of the lobes of the trap, and in which the irritability of this appendage chiefly resides, as it instantly folds together or closes on their being touched.

FIG. 15.—*a. a.* An example of the floral leaf or bracte, which is 3-lobed, in the *Euchroma coccinea* or *Bartsia.*

FIG. 16.—*a.* The ovate bud of the Tulip tree (*Lyriodendron*). *b.* The membranous concave bractes. *c.* The truncated quadrangular leaf.

FIG. 17.—A flower of the umbel of *Hoya carnosa.* *a.* The corolla. *b.* The 5 petaloid nectaries or lepanthium.

PLATE IX.

ROOTS, STEMS, AND FORMS OF INFLORESCENCE.

FIG. 1.—The fibril of a root highly magnified: *a.* the vessels in the centre seen through the cortex; *b.* the natural size of the fibrils.

FIG. 2.—A transverse section of 1. *a.* the central vessels; *b. c.* the cellular cortex. *d.* The section of its natural size.

FIG. 3.—A creeping square stem. *(Mint.)*

FIG. 4.—Spindle-shaped or Tap-root *(Radix fusiformis)* of the radish accompanied by its cotyledones and young leaves.

FIG. 5.—A tunicated or coated bulb (the Onion).

FIG. 6.—A scaly or squamose bulb (the Lily).

FIG. 7.—The palmated or hand-shaped roots of Orchis.

FIG. 8.—The radicant or clinging stem of the Ivy.

FIG. 9.—The *spike* of *Ophrys spiralis*;—the flowers seated on an elongated rachis or stalk.

FIG. 10.—The *raceme* of the Red Currant;—the flowers being pedicellate.

FIG. 11.—The twining or volubulous stem of the Convolvulus.

FIG. 12.—A branch in the form of a leaf in *Ruscus hypoglossum.* The flower arising from the leaf.

FIG. 13.—The *cyme* in a species of *Cornus.* The general peduncles from a common centre as in the umbel, but the partial ones from various parts of the primary peduncles.

FIG. 14.—The *corymbus* of the Kalmia;—with flowers from various parts of the branch, but all meeting in a flat topped cluster.

FIG. 15.—The *panicle* of *Poa pratennis*, or Meadow-grass;—an irregular and branching mode of inflorescence.

PLATE X.

VEGETABLE TEXTURES.

FIG. 1.—The *cellular texture* highly magnified, exhibiting the communicating pores and slits.

FIG. 2.—A bundle of ENTIRE VESSELS, or without perforations.

FIG. 3.—A PERFORATED VESSEL, called also *Cribriform*.

FIG. 4.—The same magnified so as to exhibit the elevated borders of the perforations.

FIG. 5.—*Moniliform* or Bead-like perforated vessels.

FIG. 6.—*Annular vessels*, the perforations or slits almost dividing the vessel into rings; their borders also elevated.

FIG. 7.—A SPIRAL VESSEL. Called also *Trachea*.

FIG. 8.—A SPIRAL VESSEL magnified, showing also the elevated, and probably glandular border; the thread of which is sometimes double.

FIG. 9.—A magnified portion of the stem of a Palm (*Ptychosperma gracilis*). *a.* The exterior ligneous and vascular bundles, which are more indurated than the interior ones. *b.* Interior ligneous and vascular bundles.

FIG. 10.—ORIGIN OF BUDS.—A transverse section of a branch of *Philadelphus coronarius* or Mock Orange, eight years old. *a. b. c.* Buds just developed, the origin of which may be traced to the first year's growth of the branch.

FIG. 11.—A portion of the two innermost ligneous circles of 10. highly magnified. *a. b. c.* The tracks of the buds conjoined, and connected with the medulla of the branch.

FIG. 12.—A wedge cut from the trunk of a Lilac tree 20 years old. *a.* A bud not yet completely developed. *b.* One fully formed: both originated in the first year's growth of the stem.

PLATE XI.

THE TEXTURE OF VEGETABLES.

FIG. 1. The LIBER, or Inner Bark. *a. a. a.* The reticular arrangement of the longitudinal fibres; and *b. b. b.* The cellular meshes.

FIG. 2.—A transverse section of the peduncle of the Water Lily (*Nymphæa odorata*), in which there are 2 series of pneumatic cells; *a.* 4 large and central; and *b.* 8 other smaller, by pairs arranged contiguous to the larger. Within the large cells, more particularly towards the root, are scattered hairs which

are 3, 4, or 5-parted: as in the figures. *c. c. c.* They occupy the situation, apparently of the medulla, but can scarcely be considered as cellular processes.

FIG. 3. A transverse slice of the petiole of *Canna indica* (moderately magnified), in which the vessels are arranged in distinct fasciculi, nearly of the same size in the centre of the section; alternately larger and smaller *(a. b. a. b.)* near the circumference on the convex surface, or that part of the petiole which is towards the under side of the leaf; and all small *(c. c. c. c. c. c.)* on the concave surface. *d. d. d.* Pneumatic or air-cells, continued also into the mid-rib.

FIG. 4.—A portion of the foliar expansion of the *Canna* magnified, in which it will be seen that the costæ or ribbed lines *e. e. e.* are continuations of those on the concave surface of the midrib, curved outwards in opposite pairs, between the basis and point of the leaf; but the central fasciculi pass along to the apex. All the lateral vessels do not go off from the midrib *(b. b.)*, but some of them are as at *a. a.* branches of others. At the margins they all inosculate.

FIG. 5.—A diagram illustrating the origin and connexion of branches. The figure may be imagined as a tree 4 years old. The cone *a.* representing the first year's growth; *b. b.* The second; *c. c.* The third, and *d. d.* The fourth. The buds furnishing the branches *e. f. g. h.* are all generated in the surface of *a.* in the spring of the first year; but on that year *e.* only sprouts into a branch; on the surface of which is generated *i*, which in its turn generates *k*. In this series, each branch has sprung in regular succession from that of the former year; the age of the branch being marked by the number of ligneous layers: thus *k*, which is one year old, is covered with one ligneous layer; *i.* with two, and *e.* with three; while the original trunk has four, which give the age of the germ whence *e.* originated. But *g.* has two layers, only, and *f. h.* no more than one, although shooting from the same surface as *e.* which is thus explained. The branch *g.* sprung from an adventitious bud, which protruded in the second year of the growth of the stem; and, therefore, although the germ whence it originated is as old as that of *e.* yet it is covered with 2 ligneous layers only; and the branch *l.* which it has protruded in regular succession, has but one, or is no older than *k.*, the third in succession on *e.* In the same manner the branches *f.* and *h*, which have also sprung from adventitious buds, are of the same age as *k*, although their germs were generated on *d.* and are consequently coeval with the first developement of the trunk.

CUTICULAR PORES.

Fig. 6.—Foliar *apertures* or *pores*, on the upper disk of the leaves of *Viola adorata* illustrative of the double ring with which they are sometimes, apparently, surrounded.

Fig. 7.—The cuticular pore in *Marchantia*, situated in the centre of a slight elevation.

Fig. 8.—The cuticular pores on the back of the leaves of Common Oleander (*Nerium Oleander*), which are oval and guarded by connivent hairs (*a. b.*) They are comparatively much larger than any of the other kinds of pores.

Fig. 9.—A transverse section of the curious pore (*d.*) of the Oleander, above, magnified, and showing its penetration into the substance of the parenchyma (*c.*) and lined internally as well as externally with hairs; its lining membrane, which is a production of the epidermis (*a.*) is not visibly porous through glasses of the highest powers. The section of this leaf, also, displays an example of a cutis consisting of 4 layers of cells. (*b.*)

Fig. 10.—The quadrilateral pore surrounded by an elevated margin, found on both surfaces of the leaves of the American Aloe (*Agave* Americana), and of all the other species of the succulent tribe to which it belongs. In the real Aloes the pores are always circular.

Fig. 11.—An example of the space between the pore, or the shield and the enclosing ring, divided into distinct portions, as seen on the lower disk of the leaves of Lilac.

Fig. 12.—A circular pore in the centre of a circular shield, as beautifully displayed, on both surfaces of *Cactus Opuntia* or the Prickly Pear.

Fig. 13.—A portion of the cuticle of the leaf of the Indian Corn (*Zea mays*), magnified. *a. a.* The cuticular or pneumatic pores. *b. b.* The supposed lymphatic vessels.

Fig. 14.—A more enlarged view of the structure of the cuticular pore in the leaf of the *Zea mays*.

Fig. 15.—The respiratory pores of the cuticle of the culm of wheat (*Triticum æstivum*).

Fig. 16.—The cuticular pores, and the course of the lymphatics on the superior disk of the leaf of *Hoya carnosa* which are nearly regular hexagons.

PLATE XII.

VEGETABLE STRUCTURES.

FIG. 1.—B. A vertical section of the dark portion of A. Fig. 2.—*a*. The cortex, consisting of,—1. the cuticle; 2. the cellular integument; 3. the vascular layer, in which the character of the proper vessels is displayed; and, 4. the liber or inner bark. *b*. The half-organized alburnum. *c*. to *d*. The perfect wood, consisting of 5. 5. 5. some porous, others entire small vessels; and 6. large porous vessels. *d*. to *e*. The medullary sheath, containing 7. 7. 7. spiral vessels, and 8.—oblong porous cells. *e*. to *f*. Pith. ** Fragments of the cells of a divergent layer. Fig. 1. A. The natural size.

FIG. 2.—A. A thin transverse slice of a twig of the Horse-chesnut (*Æsculus hippocastanum*). FIG. 2. B. The dark colored portion of the slice A. separated, and very highly magnified.—*a*. The cuticle.—*b*. The exterior layer of the cellular integument.—*c*. The interior layer of the cellular integument.—*d*. The vascular layer of the cortex.—*e*. Liber. * Alburnum in its first stage.—*f*. Perfect wood.—*g*. A divergent layer.—*h*. Large vessels of the wood.—*i*. Medullary sheath.—*k*. Pith.

FIG. 3.—A twig of *Juglans regia* (the Walnut) split to show the diaphragms which constitute its pith.


Fig 1
2.
a
b
3.
a
b
4
a
b
5
a
b
6.
7.
8.

LATHYRUS ODORATUS.

Plate 3.

Whitfield del. *Lith. of Pendleton.*

GLECHOMA HEDERACEA. *(Ground Ivy.)*

Plate 4.

Whitfield del

Lith. of Pendleton.

CORIANDRUM AMERICANUM.

Plate 5.

Whitfield del.

Lith. of Pendleton

BELLIS PERENNIS (*Daisy*)

Plate 6.

Whitfield del

Lith. of Pendleton.

Plate 7.

Whitfield del.

Lith. of Pendleton.

Plate 8.

Whitfield del.

Lith. of Pendleton

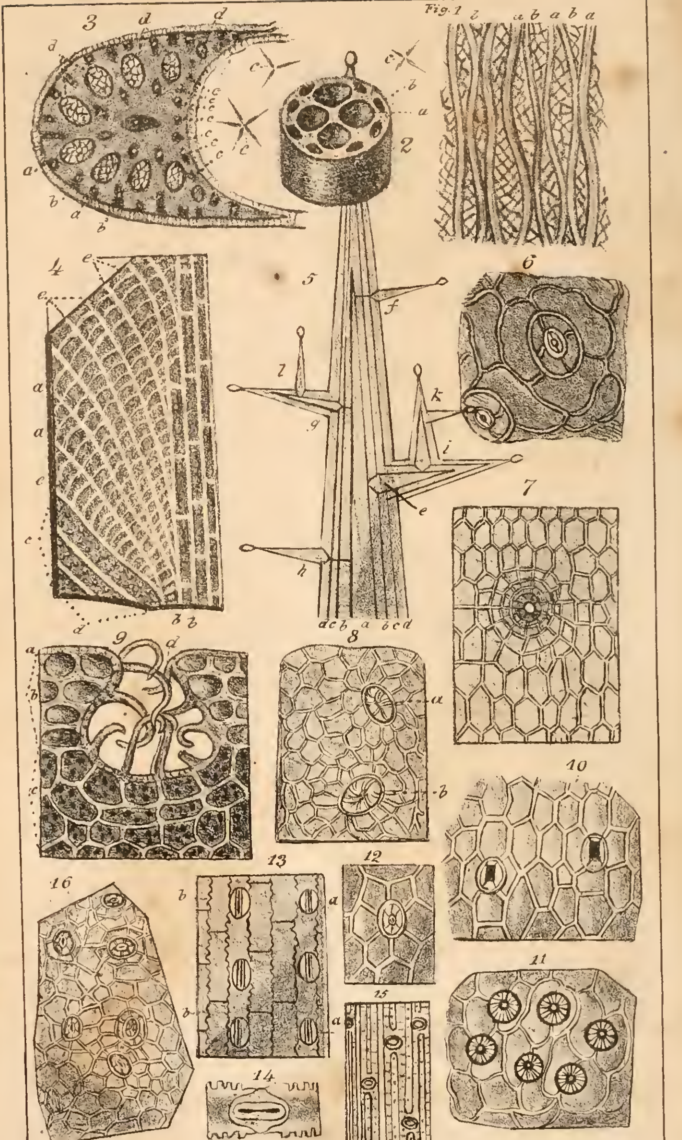
Plate 9.

Whitfield del.

Lith of Pendleton

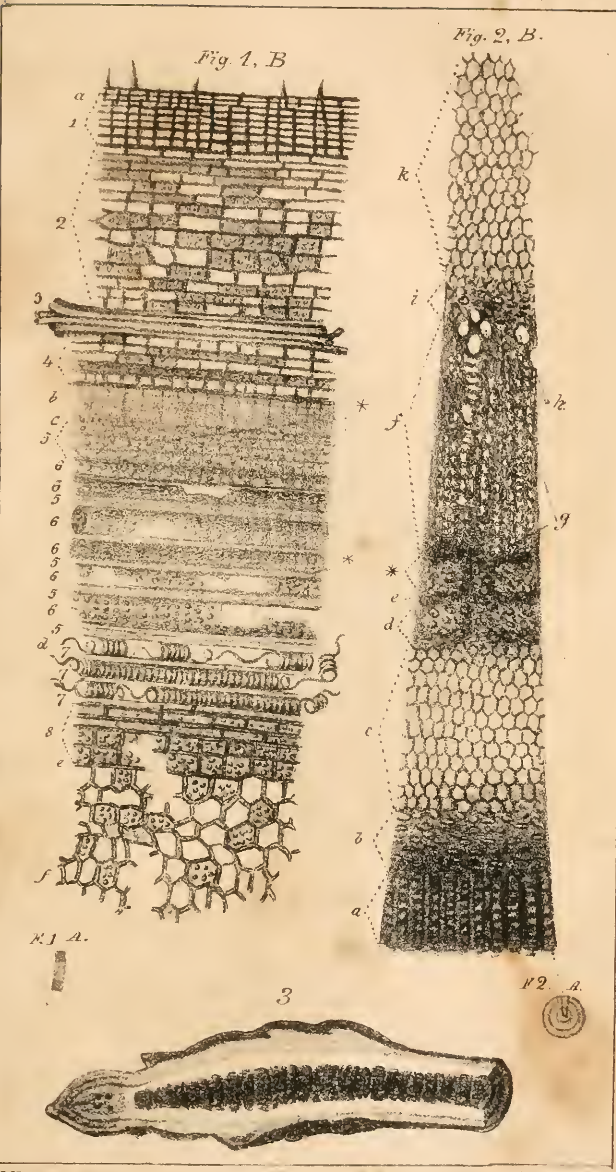
Whitfield del.

Lith of Pendleton



Whitfield del.

Lith. of Pendleton.



Whitfield del.

INDEX.

A.

B.

N.

[illegible]

[illegible] acute, [illegible]

[illegible]

[illegible] Indian ginger, [illegible]

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